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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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WESTERN HYDROELECTRIC TRANSMISSION DEVELOPMENT.

TOPOGRAPHIC STADIA SURVEYING.
BY WM. M. STRONG.

THE ELECTRIC COOKING PROBLEM.
BY R. E. FRICKEY.

N. E. L. A. CONVENTION DETAILS.

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Greetings to National Electric Light Association

For the second time in thirty-eight years the National Electric Light Association has crossed the great continental divide to meet in annual convention on the Pacific Coast. We Westerners extend warm welcome. Our latch-strings are out, our fair lands invite inspection and our brave people give cordial greetings. Abide with us and enjoy our hospitality.

For what we learn from friendly contact with the men of the East we have equally good experience to impart. Mutual understanding of diverse conditions brings unity of thought and sympathy. The true function of this convention is to instil in the minds of those who attend it a higher conception of the interests which it represents and to point out the way in which this higher conception may be translated into terms of everyday value and efficiency.

In the years to come, when the ideals brought forth at this convention shall have become the active practice of the Association's membership, may the West be pleasurably remembered as a place where history has been made and industry transformed into service.

Alphabetical Index to Advertisers, Page 12 Where to Buy It in the West, Page 13

Welcome—

Members of the
National Electric Light Association,—the

Pacific States Electric Co.,

the modern electrical supply house of the Pacific Coast, extends to members of the National Electric Light Association and their ladies a hearty welcome to the land that is DOING IT ELECTRICALLY.

To meet the demands of and encourage further developments in this great electrical field, the Pacific States Electric Company has established houses at Los Angeles, San Francisco and Oakland, California; Portland, Oregon, and Seattle, Washington, all operating under a uniform policy.

Each incorporates within itself a complete electrical supply house, embodying original and advanced methods, which time and personal experience have developed to meet Western conditions, with the latest facilities for the expeditious despatching of business, insuring not only to our customers, but to our clients, the highest efficiency in service and most practical ways of modern merchandising.

While visiting any of the cities in which we operate, the Company would deem it a special privilege and pleasure to receive and have you inspect its headquarters—make it your headquarters and enjoy its conveniences. Mail sent in our care will be properly looked after, while the retiring, rest and writing rooms are at the disposal of the ladies, and our organization is at your command.

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Distributors for the Pacific Coast

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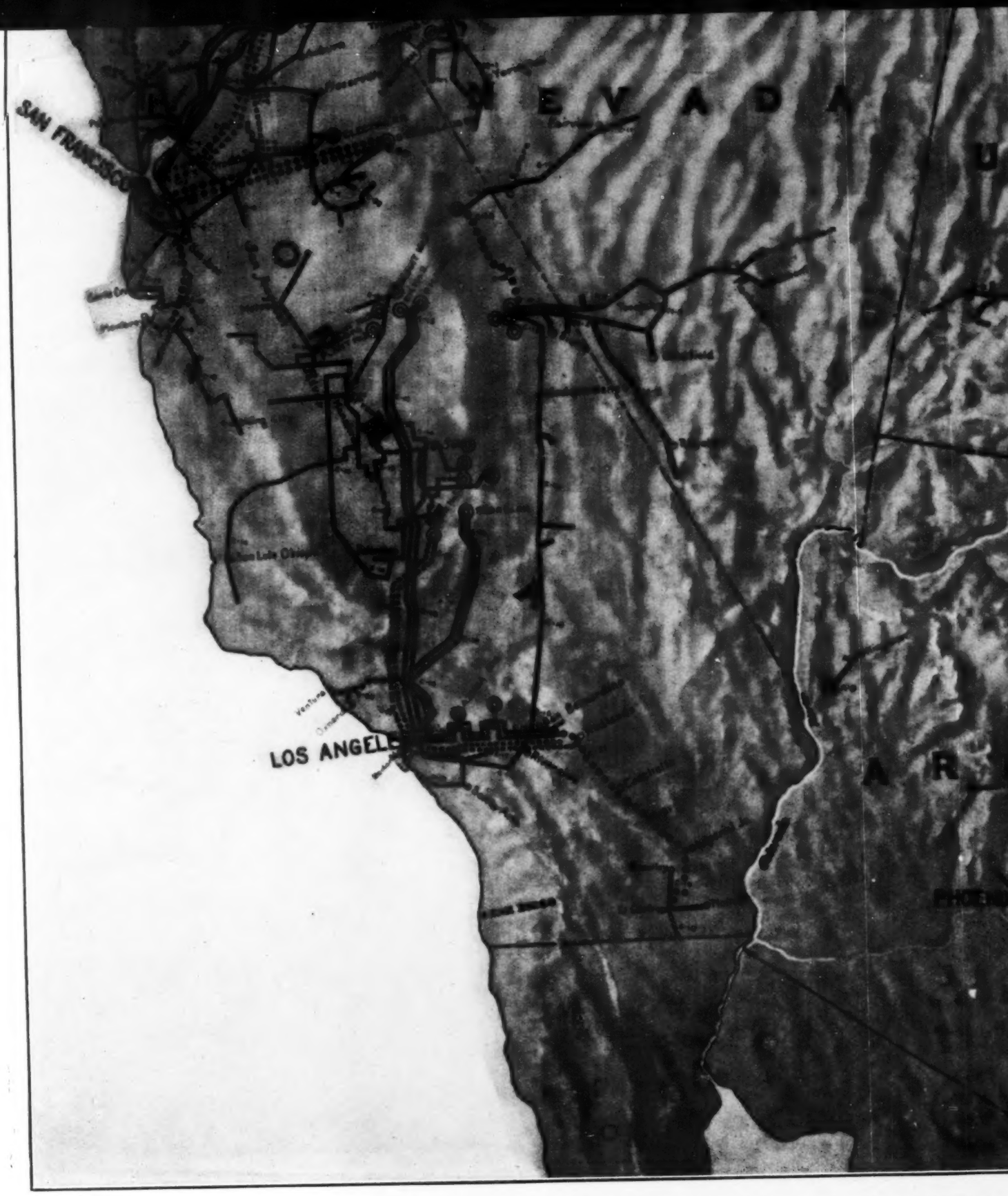
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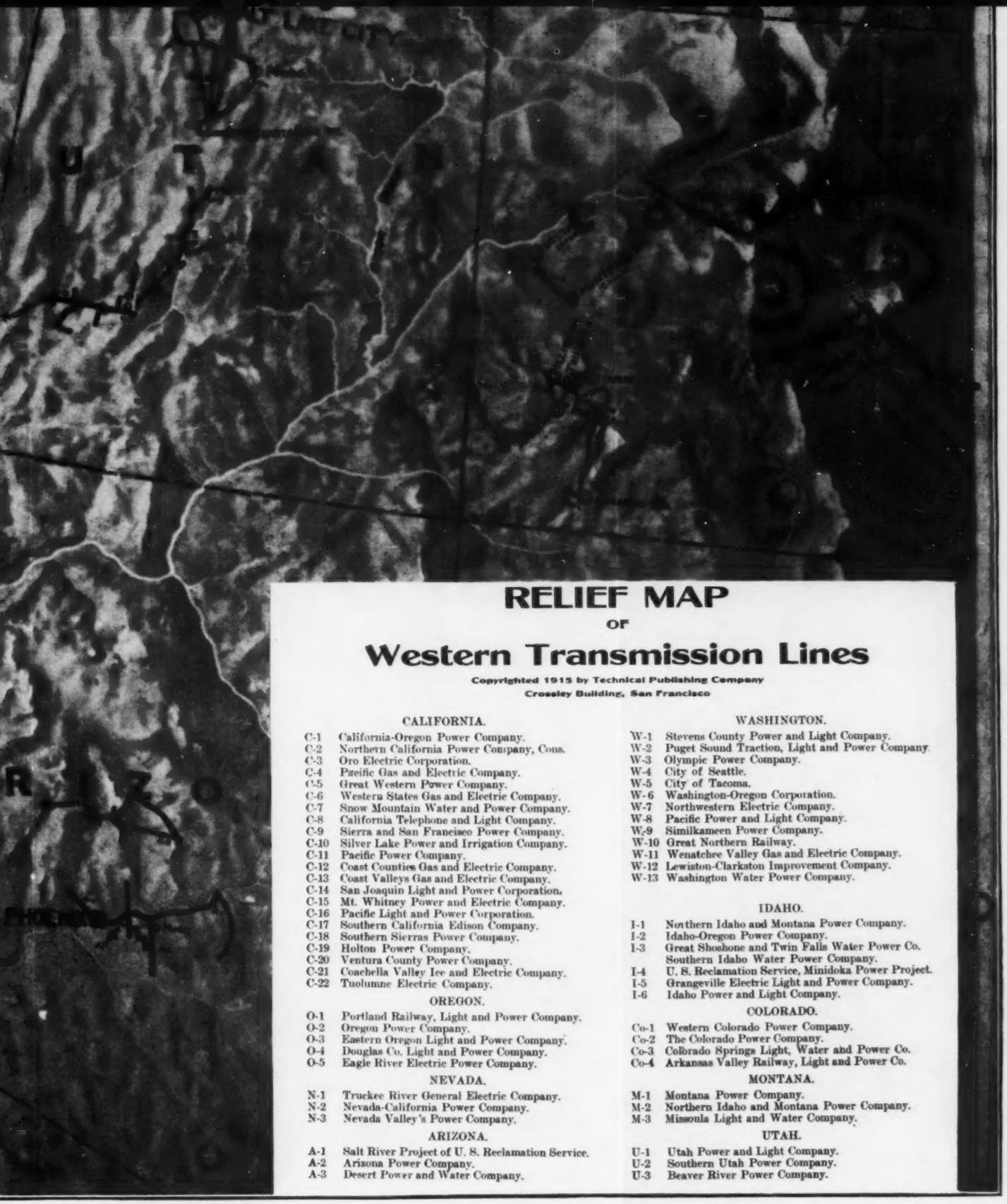

RELIEF MAP
or
Western Transmission Lines

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CALIFORNIA.

C-1 California-Oregon Power Company.
C-2 Northern California Power Company, Cons.
C-3 Oro Electric Corporation.
C-4 Pacific Gas and Electric Company.
C-5 Great Western Power Company.
C-6 Western States Gas and Electric Company.
C-7 Snow Mountain Water and Power Company.
C-8 California Telephone and Light Company.
C-9 Sierra and San Francisco Power Company.
C-10 Silver Lake Power and Irrigation Company.
C-11 Pacific Power Company.
C-12 Coast Counties Gas and Electric Company.
C-13 Coast Valleys Gas and Electric Company.
C-14 San Joaquin Light and Power Corporation.
C-15 Mt. Whitney Power and Electric Company.
C-16 Pacific Light and Power Corporation.
C-17 Southern California Edison Company.
C-18 Southern Sierras Power Company.
C-19 Holton Power Company.
C-20 Ventura County Power Company.
C-21 Coachella Valley Ice and Electric Company.
C-22 Tuolumne Electric Company.

OREGON.

O-1 Portland Railway, Light and Power Company.
O-2 Oregon Power Company.
O-3 Eastern Oregon Light and Power Company.
O-4 Douglas Co. Light and Power Company.
O-5 Eagle River Electric Power Company.

NEVADA.

N-1 Truckee River General Electric Company.
N-2 Nevada-California Power Company.
N-3 Nevada Valley's Power Company.

ARIZONA.

A-1 Salt River Project of U. S. Reclamation Service.
A-2 Arizona Power Company.
A-3 Desert Power and Water Company.

WASHINGTON.

W-1 Stevens County Power and Light Company.
W-2 Puget Sound Traction, Light and Power Company.
W-3 Olympic Power Company.
W-4 City of Seattle.
W-5 City of Tacoma.
W-6 Washington-Oregon Corporation.
W-7 Northwestern Electric Company.
W-8 Pacific Power and Light Company.
W-9 Similkameen Power Company.
W-10 Great Northern Railway.
W-11 Wenatchee Valley Gas and Electric Company.
W-12 Lewiston-Clarkston Improvement Company.
W-13 Washington Water Power Company.

IDAHO.

I-1 Northern Idaho and Montana Power Company.
I-2 Idaho-Oregon Power Company.
I-3 Great Shoshone and Twin Falls Water Power Co.
Southern Idaho Water Power Company.
I-4 U. S. Reclamation Service, Minidoka Power Project.
I-5 Grangeville Electric Light and Power Company.
I-6 Idaho Power and Light Company.

COLORADO.

Co-1 Western Colorado Power Company.
Co-2 The Colorado Power Company.
Co-3 Colorado Springs Light, Water and Power Co.
Co-4 Arkansas Valley Railway, Light and Power Co.

MONTANA.

M-1 Montana Power Company.
M-2 Northern Idaho and Montana Power Company.
M-3 Missoula Light and Water Company.

UTAH.

U-1 Utah Power and Light Company.
U-2 Southern Utah Power Company.
U-3 Beaver River Power Company.

Co-2
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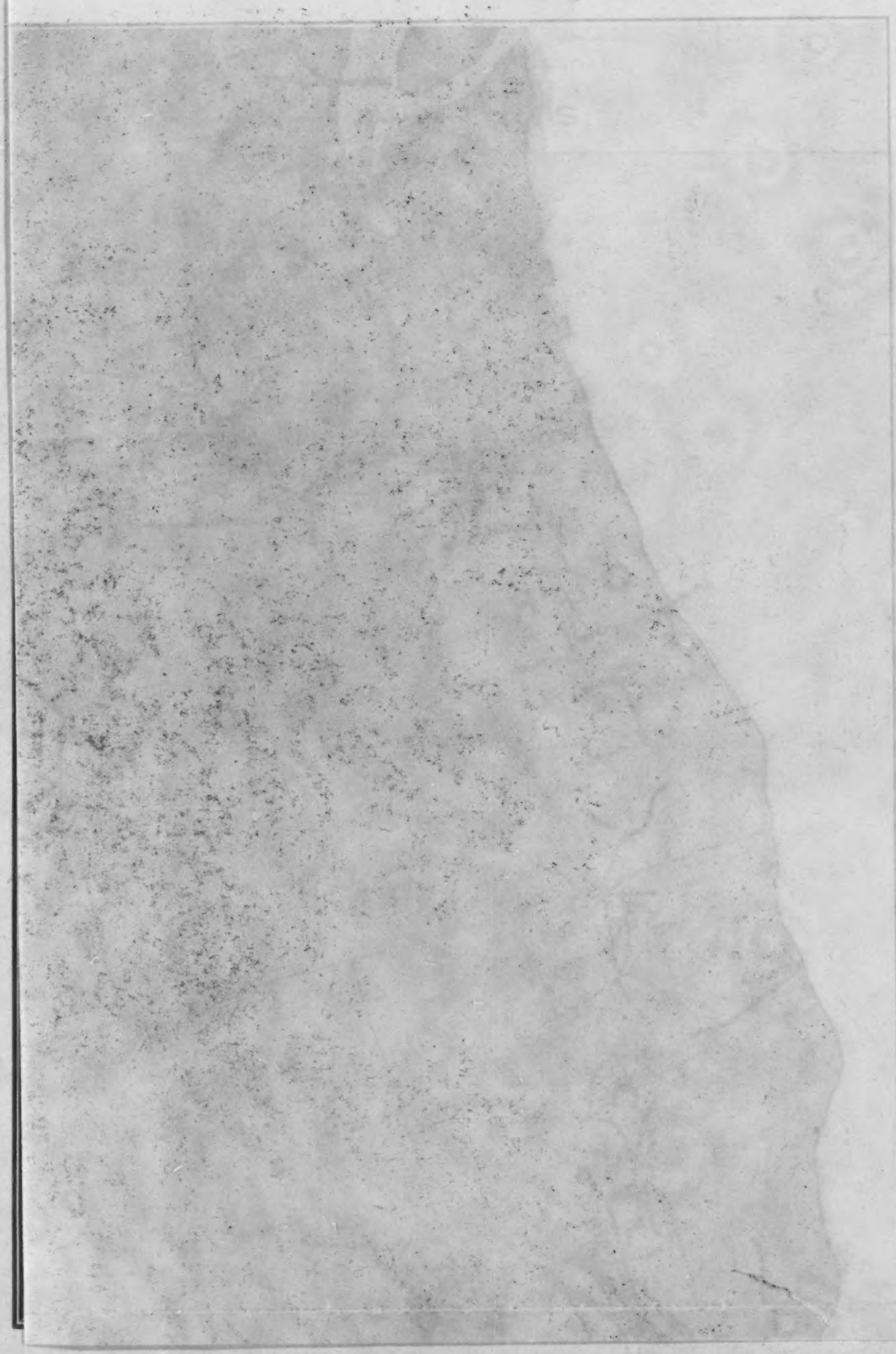
TRICITY POWER AND GAS, JUNE 5, 1915



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Whence Comes the Power.

Western Hydroelectric Transmission Developments

(This paper constitutes the report of the sub-committee of the National Electric Light Association's hydroelectric section and deals with water power development in the West. The members of the committee are P. M. Downing, O. B. Coldwell, E. R. Davis, C. C. MacCalla and W. G. B. Euler. The paper is to be read at the San Francisco convention, June 7-11, 1915.—The Editor.)

Introduction.

The use of water for the recovery of gold by hydraulic mining was a well established industry on the Pacific Coast long before it was known that the energy of a stream could be changed into such form as to permit its being transmitted for hundreds of miles over metallic circuits. The hardy miners of '49 and the early '50's harnessed the waters of these streams and constructed dams for holding back the flood waters of the mountain slopes that it might be available for their mining operations during the short water seasons, long before conservation became an issue. But following the early day excitement of the mad rush for gold, there came out from the East more conservative men to engage in other lines of business. People began to realize that the entire wealth of the Pacific Coast was not in the mines, but that the virgin forests and the fertile valleys offered even greater opportunities to the homeseekers than did the mines. First came the stockmen, who were free to run their cattle wherever they cared without interference from any one, except others engaged in the same occupation, who might feel that their pre-empted rights were being infringed upon. Then came the farmer, or, as he has generally been called in California, the "rancher," who, without other means of transporting his produce to market, had to rely on water transportation.

Meanwhile hydraulic mining had developed to such proportions that the debris was being deposited in the valleys to such an extent that the original river channels would no longer carry the flood waters. Each year the levees along these streams would be raised higher, until finally in the early '70's, after a long and bitter fight between the valley farmers and the mountain miners, the California legislature passed a law pro-

hibiting hydraulic mining, except under certain restrictions requiring the construction of such restraining dams for impounding the debris as would meet with the approval of properly authorized representatives of the state and federal governments. The result of this adverse legislation was the almost complete cessation of mining operations, except in a few isolated instances where conditions were such that dams could be constructed at costs that were not prohibitive. The ditches and water systems that had formerly furnished water to the mines were abandoned, and many of the companies either went into bankruptcy or disposed of their property for almost anything they could get for it. The farmers and fruit growers had not yet begun to realize the importance and necessity of irrigation to make their lands produce to their fullest extent, so that there was but a limited market for the sale of water for irrigation purposes, and it was not until the early '90's, after it had been proven beyond any question of doubt that electrical energy could be transmitted for considerable distances, that the real value of water power resource began to be fully realized.

In the Pacific Northwest the conditions were somewhat different. Although the beneficial use of water in this section dates back almost as far as it does in California, it was used for a different purpose. There was comparatively little mining, but the early settlers in the Willamette Valley, shipping their produce and supplies up and down the Willamette River, and having to transfer them by pack trains around the falls at Oregon City, soon began to make use of the waters of those falls for the operation of grist and woolen mills and such other industries as would give them a more ready market for the products of their farms.

Generally speaking the water conditions in the northern Pacific Coast states are more favorable throughout the entire year than they are further south. This section has a greater normal rainfall, and with the shorter dry season there is less fluctuation in the stream flow. A similar condition is noticeable in Northern California, where the rainfall is greater than in the south, and the volcanic ash soil retains the moisture much better than does the decomposed granite formation in the southern portion. For this reason, therefore, practically every transmission in the state runs in a southerly or southwesterly direction, that is, from the western slope of the Sierra Nevada Mountains south into the more thickly populated valleys.

Although the potential possibilities of using the natural fall of a stream for the development of power had been known for many years, it was not until 1889, after the art of electric transmission had been proven possible, that the first hydroelectric plant on the Pacific Coast, and for that matter the first of its kind in America, was installed at Oregon City.

But the electrical industry was still in its infancy, the manufacturers were unwilling to hazard their reputations by attempting to build transformers for voltages of 10,000 or over, and the most optimistic promoters were not able to interest capital in so new an enterprise. The development of the industry, therefore, was slow, and it was not until 1895 that long distance transmission of power came to be recognized as a practical and commercial possibility.

One of the greatest incentives to the development of hydroelectric power on this coast has been the high cost of fuel. Practically all of the timber is pine, spruce, fir, cedar, or other varieties entirely unsuited for heating purposes. Coal has to be imported from British Columbia, or Australia, and costs in carload lots approximately $7.00 per ton. Oil has been produced in California ever since 1876, but it was not until about 1895 that it became available in such quantities as to consider it a possible steam-producing substitute for coal. However, it is now the standard fuel not only in California, but also to a considerable extent the standard in both Oregon and Washington. Although the production of oil in California has increased from, approximately, 300,000 bbl. in 1890 to over 100,000,000 bbl. in 1914, the price has not materially changed during that time, but has generally averaged between 75c to $1.00 per barrel of 42 gallons. The comparative costs of the two fuels, considering equivalent heat values, on the basis of the above prices, are in the approximate ratio of 82 to 72, thus under ordinary conditions making oil fuel about 14 per cent cheaper than coal.

Notwithstanding this lower cost of fuel oil and the fact that the more efficient steam turbines have come into general use, the hydroelectric industry has become so well established that the progress of its development has not been retarded by the use of steam. As will be seen by the following table showing the number of California plants in operation, by years, from 1902 to 1914, together with their combined capacities, the development has been rapid and consistent.

NUMBER AND INSTALLED CAPACITY OF HYDRO PLANTS IN CALIFORNIA.

Year.	Number of Plants.	Total Kilowatt Capacity.
1892	1	480
1893	2	1,230
1894	2	1,230
1895	4	5,730
1896	7	8,190
1897	9	12,440
1898	15	20,715
1899	19	27,175
1900	20	28,695
1901	23	38,015
1902	27	51,565
1903	33	65,075
1904	41	88,465
1905	50	100,115
1906	54	122,265
1907	58	161,465
1908	67	238,985
1909	69	248,285
1910	71	293,095
1911	71	298,595
1912	72	308,295
1913	78	420,045
1914	79	436,045

The installations of California are not limited to any one particular stream or watershed, but are fairly well distributed over the entire state. The following table shows the developed and undeveloped possibilities of the more important sources of water supply:

SOURCES OF DEVELOPED AND UNDEVELOPED WATER POWER IN CALIFORNIA.

Source—	Number of Electrical Units.	Total KW. Developed.	Estimated KW. Undeveloped.
Sacramento River	63	184,437	3,435,000
San Joaquin and Kern Ri.	48	181,377	2,355,000
Minor Coast Streams.....	29	24,150	900,000
East Sierra-Nev. Drainage.	26	36,382	151,500
Klamath and Rogue Rivers	11	9,699	27,300
Totals	177	436,045	6,868,800

In Washington the hydroelectric development is estimated at 300,000 kw., and in Oregon at over 100,000 kw.

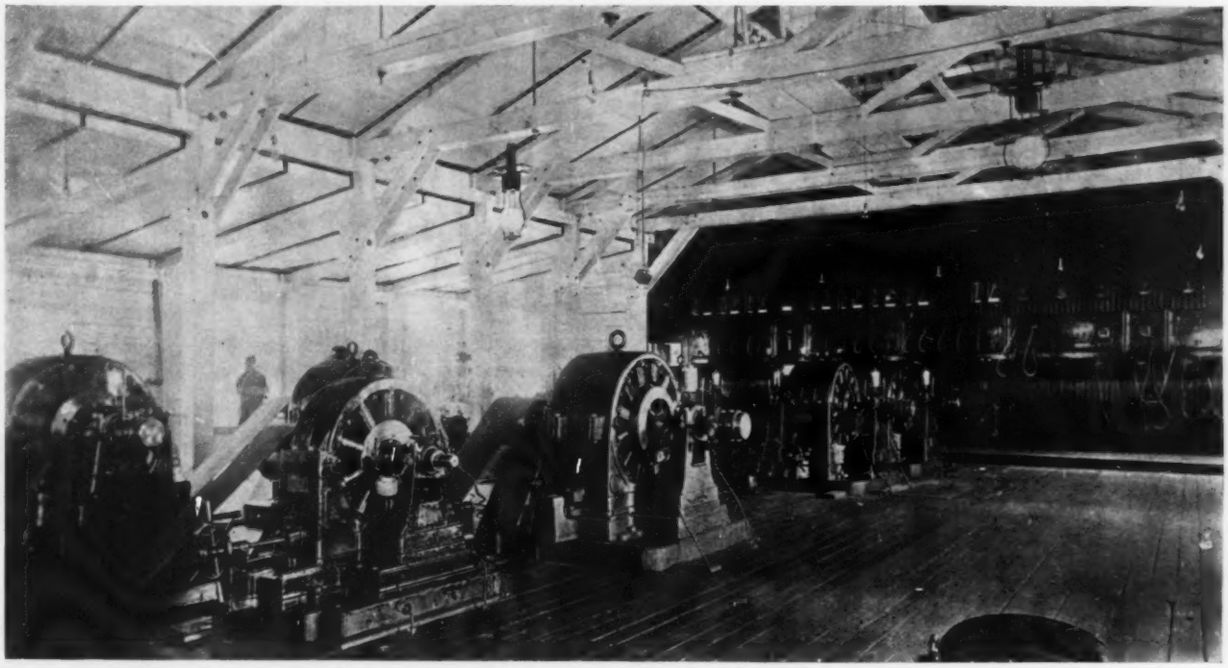
As a natural result of pioneer work, the early day hydroelectric stations were small and the equipment of such design and character as could not be depended upon to give satisfactory service under the heavier loads and more rigorous demands for better and more reliable service. The old plant at Oregon City, with its 120 kw. "dynamos," as they were called at that time, run entirely independent of each other, and supplying power over separate circuits to Portland, might justly be looked upon today as obsolete, but it was modern then. The 750 kw. generators at Folsom were, when they were installed, the largest of their kind that had ever been built, and although they have been in service for less than twenty years, they are obsolete now, both as regards design and capacity and would not be considered for a present day installation. Who knows but what the 10,000 and 15,000 kw. units being installed today will, within a comparatively few years, be superseded by ones of even larger capacity?

As voltages increased and lines carrying heavier loads were extended into new territory, it soon became apparent that a different type of switch other than the crude air-break types then in use must be had. The manufacturers were unable to meet the demands for suitable oil switches, and it remained for the pioneer high voltage transmission engineers of the Pacific Coast to design and build their own high tension switches.

Except for the increased size and improved design to meet higher voltage requirements, line insulators and line construction methods have not materially changed during recent years. Important high voltage trunk lines are generally carried on steel towers, using suspension insulators, but the less important distributing circuits are still being built along the same general lines as they were twenty years ago.

The World's First Hydroelectric Plants.

The art of transmitting electrical energy for considerable distance at high voltage dates back only a comparatively few years. The first installation of this kind was the one at Cerchi, Italy, made in 1886, and known as the "Cerchi Tivoli-Rome Plant." The equipment in this station consisted of two 150 h.p. steam driven, single phase Ganz generators, designed to operate at 112 volts. Transformers having a ratio of 1/18, were used to step from this voltage up to 2000, at which latter voltage energy was transmitted to Rome, a distance of seventeen miles. This was the first high voltage transmission line in the world. In 1889 the capacity of this steam plant had been increased to 2700 h.p.



Interior of Original Willamette Falls Plant, the First Hydroelectric Transmission in America.

In 1892 this same company built their Tivoli hydro-electric plant for use in conjunction with the Cerchi steam station. Here were installed four 250 kw. three phase Ganz generators, direct connected to water driven turbines. With the completion of this new installation the line voltage was increased to 10,000 and made three phase.

In 1887 Tesla, Ferraris and Bradley pointed out the advantages of three phase over single phase for the transmission of energy, but it was not until 1891 that the first commercial three phase transmission line was put into successful operation. On September third of that year the 112-mile Lauffen-Frankfort line

supplying a lighting load in the City of Frankfort was first put into service. The power house installation consisted of one 225 kw., three phase generator, direct connected to a water driven turbine, operating under a head of 10 ft. The line voltage was 12,000.

The unqualified success of this undertaking almost from its inception gave a great impetus to the industry, and before the end of the year at least one other three phase transmission, that of the Oerlikon Manufacturing Company of Zurich, Switzerland, had been put into successful operation, and at least eight other plants having an aggregate capacity of 1350 kw. had been contracted for.

First Hydroelectric Transmission in America.

The first hydroelectric installation in America was the one at Oregon City, now owned by the Portland Railway, Light & Power Company. This was installed by the Willamette Falls Electric Company in 1889, who utilized the water power of the falls at that place for the generation of electric power, and transmitted it to Portland for general distribution purposes. The installation consisted of six 80 kw., 4000 volt, single phase, 125 cycle alternators, and several arc machines, all of which had formerly been in operation in a steam driven station in Portland. These machines were a departure from the standard design of that time in that their voltage was higher than had ever before been attempted. The transmission line carried 4000 volts, and was made up of individual circuits running from the different generators in the power house to the steam plant in Portland, a distance of 13 miles. With the increase in load the number of circuits on this line was increased from time to time until ultimately it carried about thirty wires and resembled a telephone lead more than a present day transmission line.

In 1890, shortly after the Willamette Falls Electric Company had completed their installation at Oregon City, the Telluride Power Company installed at Ames, Colorado, two 150 kw. single phase Westinghouse generators, directly connected to Pelton water wheels operating under a head of 500 ft. Power was transmitted to Telluride, a distance of five miles, at 3000 volts.

The Pomona plant of the San Antonio Light & Power Company, at Pomona, California, was the first to use a voltage higher than 4000 or to transmit more than 14 miles. In 1891 Mr. William Decker and Professor C. G. Baldwin developed the power on San Antonio Creek and transmitted power at 10,000 volts to Pomona, 13 miles away, and San Bernardino, 28 miles away. After the Westinghouse Company refused to build three phase generators, it was decided to install 120 kw., 200 volt, 800 alternation, single phase units. The potential was stepped up to 10,000 volts by means of twenty 6½ kw. transformers, connected in series. Power was transmitted to San Bernardino, 28 miles distant, with almost as perfect regulation as was given by the steam plant in that city. The plant, which at the time was the longest high tension transmission in the world, was built under the direction of L. B. Stillwell, and was successful from the beginning. The price for arc lights averaged $8.00 per month, and for incandescent lamps 50c to 80c per light per month. The original plant was dismantled in 1902. The water rights now constitute a portion of the developments of the Pacific Light & Power Corporation.

Mr. Decker was not to be dismayed in his plans for the three phase plant, but during the same year, 1891, arranged with the General Electric Co., through the Redlands Electric Light & Power Company, for

Mill Creek Power House No. 1, the First Three-Phase Transmission in America.

delivery of two 250 kw., 2400 volt, three phase generators, for direct connection to Pelton water wheels, operating under a static head of 295 ft. These were installed in Mill Creek Power House No. 1, in June, 1892, and first put into operation on September 7, 1893, delivering power 23 miles to Riverside, California, at a potential of 10,000 volts. This was the first three phase installation and transmission in America.

Another early installation was that of the Walla Walla Gas & Electric Company, at Walla Walla, Washington, in 1892. Here a 100 kw., 2000 volt single phase T. H. generator supplied power direct to the city of Walla Walla over a line five miles long.

The next three phase installations of note were a 300 kw. plant at Silver City, Colorado, in 1894, a 3000 kw. plant at Folsom, California, by the Folsom Water Power Company, in July, 1895, and a 5730 kw. plant at Oregon City by the Portland General Electric Company in September, 1895.

DEVELOPMENTS IN THE PACIFIC NORTHWEST

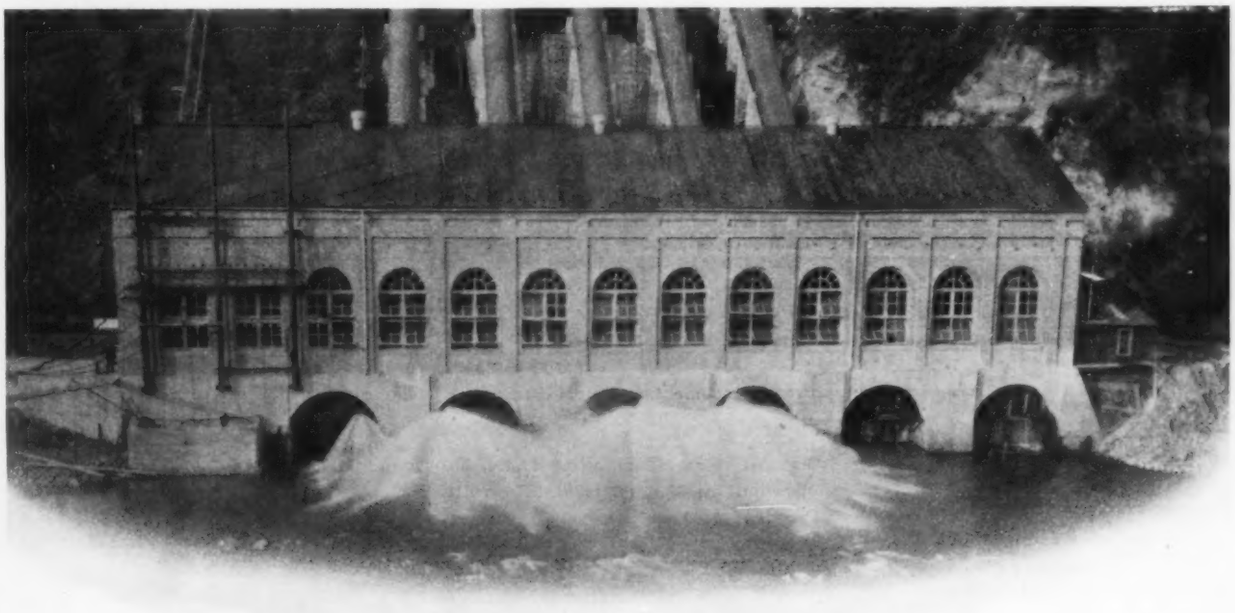
Portland Railway Light & Power Company.

As has already been noted, the first hydroelectric installation in America was that at Oregon City for supplying power to the City of Portland. The growth of that city since the early '80's has been rapid, and notwithstanding the lower cost of fuel in that territory, as compared with other parts of the Pacific Coast, the commercial possibilities of the utilization of the water power of the falls in the Willamette River at Oregon City for the development of electric power were early recognized.

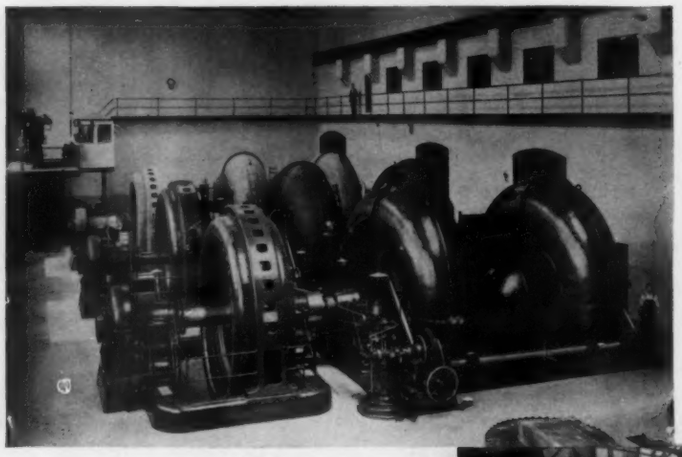
The first installation, known as "Station A," was on the east side of the river, and contained six 80 kw., 4000 volt, 125 cycle, single phase Westinghouse generators, two 120 kw., 200 volt, 125 cycle, single phase Westinghouse generators, and eleven 100 light, 2000 c.p. Excelsior arc light machines. This station was operated until 1895, when Station "B," on the west side of the river, was put into service, when it was abandoned.

The original Station "B" installation consisted of two 540 kw. units, three 500 kw. units, and three 450 kw. units, all General Electric, three phase 33 cycle, 10,000 volts, direct connected to Victor turbines. Subsequently there were added four more 450 kw. units, making a total of seven of this capacity and a total power house capacity of 5750 kw. The lower frequency of the equipment in Station "B" was determined upon as being best suited to meet the various conditions imposed by a mixed load, consisting of incandescent and arc lighting and power service, together with the operation of rotaries for railway service. The subsequent establishment of a periodicity of 60 cycles as standard for light and power work made necessary the installation of frequency changers in the Portland substation.

The next important installation of this company was made in 1907, and known as the "Cazadero Plant." It is located on the Clackamas River, 31 miles from Portland. This installation consists of two 2500 kw. Allis-Chalmers 33 cycle, 3 phase, 11,000 volt generators, each direct connected to a 5000 h.p., 42 in. horizontal type Victor high pressure turbine, operated under a 125 ft. head, and one 2500 kw. General Electric



Cazadero Plant, Portland Railway, Light & Power Company.



INTERIOR VIEW OF
RIVER MILL POWER STATION
ONE OF THE COMPANY'S
HYDRO-ELECTRIC PLANTS

INTERIOR VIEW OF
POWER STATION "L"
ONE OF THE COMPANY'S
STEAM-ELECTRIC PLANTS

60 cycle, 3 phase, 10,000 volt generator, direct connected to the same type and size of turbine. This company now has in Portland, and the lower end of the Willamette, five hydroelectric plants, having an aggregate capacity of 43,000 kw., and five steam generating stations with a combined capacity of 22,500 kw., or a total capacity of 65,000 kw. It also has 25 substations, and 277 miles of high tension transmission lines.

GROWTH OF PORTLAND RAILWAY, LIGHT & POWER CO.
PORTLAND, OREGON.

Year.	No. of Electric Consumers.	Light & Power Gross Electric Revenue.	Kilowatt Hrs. Generated. Hydro.	Steam.	System Load Factor.	Miles H T. Transmission.	Miles Overhead Distr.	Plants Installed Hydro No.	Hydro KW.	Steam No.	Steam KW.	*Gross Revenue All Depts.
1907	12,294	$1,025,814	54,442,800	17,833,437	42.6%	....	....	3	13,500	5	10,300	$4,050,144
1908	15,681	1,188,265	75,797,430	10,914,519	42.9	....	...	3	13,500	5	10,300	4,351,676
1909	20,503	1,392,483	91,062,924	7,091,450	44.6	....	....	3	16,500	5	10,300	4,818,022
1910	26,413	1,709,988	102,708,027	17,995,688	44.2	....	....	3	21,000	6	12,300	5,638,895
1911	33,192	2,069,351	131,478,207	20,766,060	47.5	....	4360	4	28,300	4	14,000	6,336,703
1912	38,415	2,327,822	150,163,276	19,445,728	45.5	271	5780	5	43,000	5	16,500	6,642,308
1913	42,062	2,416,305	152,388,705	31,812,115	46.6	272	6301	5	43,000	5	22,500	6,685,841
1914	 37,938	2,241,834	162,125,167	22,640,982	47.6	277	6880	5	43,000	5	22,500	6,273,170

*The above figures for Gross Revenue show the income from every source, as electric sales, gas and street railways.

Franklin, T. Griffith, President.
F. I. Fuller, Vice-President.
G. L. Estabrook, Secretary.
C. N. Huggins, Treasurer.
F. W. Hild, General Manager.
O. B. Coldwell, Gen. Supt. Light and Power Dept.
C. D. Searing, Engineer of Elec. Con.
W. J. Morris, Purchasing Agent.

Transmission: 277 miles at 57,000, 33,000 and 11,000 volts.

Distribution: 6880 miles at 2400 volts.

Frequency: 33 and 60 cycles.

Service: electric light, power and railway for 310,000 population by means of five hydroelectric and five steam-electric power plants.

Washington Water Power Company.

For a number of years prior to 1906 the Washington Water Power Company operated a small hydroelectric plant almost in the center of the City of Spokane, supplying direct current power for both railway and general distribution purposes, but there was a continually increasing demand for service in the outlying districts that could not be served with direct current.

The year 1906 marked the beginning of long distance transmission with this company, when they placed in operation their first hydroelectric installation of 9000 kw. at Post Falls, and transmitted almost the entire output of the plant to the Coeur d'Alene mining district in Idaho, a distance of 20 miles. The success attending the use of electric power in these mines soon enabled the company to dispose of their entire output, and in 1910 the first three 5000 kw. units were installed in the Little Falls plant.

Since then one more unit of the same size has been added, thus giving a total capacity to this station of 20,000 kw.

The Long Lake plant, which will ultimately have a capacity of 56,000 kw., has since January 1, 1915, been put into service with the first two 14,000 kw. units in operation.

Long Lake Plant, Washington Water Power Company.

D. L. Huntington, President.
C. S. MacCalla, Vice-Pres. & Gen. Mgr.
C. F. Uhden, Chief Engineer.
J. B. Fisken, Superintendent.
V. G. Shinkle, Purchasing Agent.

Transmission: 599 miles at 60,000 volts, 32 miles at 22,000 volts.
Distribution: 763 miles at 6600, 4000 and 2300 volts.
Connected Load: 14,000 kw. residence lighting, 8500 kw. commercial lighting, 30,830 kw. industrial power, 5364 kw. electric railway.
Invested Capital: $15,490,000.

GROWTH OF WASHINGTON WATER POWER COMPANY, SPOKANE, WASH.

Year.	No. of Electric Consumers.	Light & Power Gross Electric Revenue.	Steam Kilowatt Hrs. Generated.	System Load Factor.	Miles H.T. Transmission.	Miles Overhead Distr.	Plants Installed. Hydro. No.	Plants Installed. Hydro. KW.	Gross Revenue All Depts.
1903	4,061	$ 321,890	.....		100	...	1	6,500	$ 325,313
1904	5,187	456,219	.....	43.4%	124	...	1	8,750	457,978
1905	6,556	579,207	.....	48.2	140	...	1	8,750	582,416
1906	7,954	740,730	.....	44.6	239	...	2	17,750	743,628
1907	10,454	1,026,225	115,150	53.5	281	...	2	20,000	1,030,455
1908	12,936	1,242,124	2,510,310	57.3	405	...	2	20,000	1,244,989
1909	15,584	1,465,980	3,953,810	53.6	436	...	2	20,000	1,471,454
1910	18,080	1,685,895	833,170	56.4	478	...	3	35,000	1,692,633
1911	19,105	1,856,803	2,060	55.0	525	...	3	40,000	1,863,586
1912	20,222	1,880,429	830	59.2	525	538	3	40,000	1,890,410
1913	24,426	1,944,445	.....	61.3	560	674	3	40,000	1,967,130
1914	29,119	2,083,597	.....	65.3	631	748	3	40,000	2,104,526

Northwestern Electric Company.

This company is a comparatively new one in the field on the Pacific Coast, it having only recently started to operate in Portland and vicinity. Their first hydroelectric installation, consisting of two 6000 kw. units, is located on the White Salmon River, and known as the Condit plant. It was first placed in operation in April, 1913, delivering power over 65 miles of 70,000 volt line to Portland, where an auxiliary steam station of 7500 kw. capacity is operated.

Herbert Fleishhacker, President.
M. Fleishhacker, Vice-President.
W. E. Coman, Vice-President.
R. E. Wallace, Secretary.
W. E. Coman, Manager.
L. T. Merwin, Superintendent.
B. C. Condit, Chief Engineer.
G. L. Whipple, Purchasing Agent.

Transmission: 64.5 miles at 66,000 v.
Distribution: 163.7 miles at 11,000, 2400 and 120/240 volts.
Connected Load: 6240 kw. residence lighting, 5224 kw. commercial lighting, 8366 kw. industrial power.

Northwestern Electric Company's Hydroelectric Plant.

GROWTH OF NORTHWESTERN ELECTRIC COMPANY, PORTLAND, OREGON.

Year	No. of Electric Consumers.	Light and Power Gross Electric Revenue.	Steam K.w.-hrs. Generated.	System Load Factor.	Miles Trans-mission.	Miles H.T. Overhead Distr.	Plants Installed Hydro. No.	Hydro. KW.	Steam. No.	Steam. KW.
1913	10	$ 56,447		70%	65	5	1	12,000	1	7,500
1914	6,497	313,307	825,590	50	65	105	1	12,000	1	7,500

GROWTH OF WEST KOOTENAY LIGHT & POWER COMPANY. ROSSLAND, BRITISH COLUMBIA.

Year.	No. of Electric Consumers.	Light & Power Gross Electric Revenue.	System Load Factor.	Miles H. T. Transmission.	Miles Overhead Distr.	Plants Installed Hydro. No.	Hydro. KW.	Total Connected Load H.P.
1900	718	$ 82,905	90%	46	30	1	3,000	9,800
1901	719	104,744	93	46	30	1	3,000	9,800
1902	722	97,643	85	46	30	1	3,000	9,800
1903	721	107,273	93	46	30	1	3,000	9,800
1904	721	112,246	89	46	30	1	3,000	9,800
1905	720	130,500	90	250	60	1	3,000	19,100
1906	719	142,588	89	250	60	1	3,000	19,600
1907	718	178,726	89	250	60	3	23,000	20,100
1908	721	284,874	84	250	60	3	23,000	20,600
1909	726	308,430	86	250	60	3	23,000	21,106
1910	726	319,514	87	250	60	3	23,000	21,606
1911	726	314,298	85	250	60	3	23,000	21,606
1912	726	239,891	89	250	60	3	23,000	21,606
1913	723	406,685	90	250	60	3	23,000	21,606
1914	722	413,884	79	250	60	3	23,000	21,606

West Kootenay Light & Power Company.

The West Kootenay Light & Power Company's first installation of 3000 kw. was made in 1899, and supplied power at 20,100 volts to Spokane and vicinity. In 1907 two additional plants, having a combined capacity of 20,000 kw., were added, thus giving a total capacity of 23,000 kw. at the present time.

Practically the entire output of this company's plants is now sold to mining companies for the operation of smelters, compressors, etc., all of which have exceptionally high load factors. During the fourteen years from 1900 to 1914, for which time data of their system is available, the number of their consumers has remained practically constant.

Transmission Line, Outdoor Substation, and Service Connection of Oregon Power Company.

The Oregon Power Company.

The Oregon Power Company operates in Eugene, Oregon, and vicinity, having a single 500 kw. hydroelectric installation and four steam plants. The company is owned and controlled by the Northern Idaho & Montana Power Company, a subsidiary of H. M. Byllesby & Co.

Elmer Dover, President.
Attilla Norman, Vice-Pres. & Gen. Mgr.
R. S. Smith, Secretary.
A. L. Ingalls, Treasurer.
F. C. Burke, Superintendent.
W. L. McCullough, Electrical Engineer.
F. G. Wing, Purchasing Agent.

Transmission: 91.6 miles at 66,000, 33,000/11,000.
Distribution: 912 miles at 2300/230/115/115.
Connected Load: 8104 kw. lighting, 4882 kw. industrial power, 103 kw. electric railway.

GROWTH OF OREGON POWER COMPANY, PORTLAND, OREGON.

Year.	No. of Electric Consumers.	Light and Power Gross Electric Revenue.	Steam Kw.-Hrs. Generated.	System Load Factor.	Miles H. T. Transmission.	Miles Overhead Distr.	Plants Installed Hydro. No.	Plants Installed Hydro. Kw.	Gross Revenue All Depts.
1910	5,861	$152,679	3,520,762	42%	26	298	1	500	$152,679
1911	7,041	250,428	6,083,053	40	92	480	1	500	250,428
1912	7,213	272,895	6,002,780	40	92	531	1	500	272,895
1913	7,960	298,228	6,449,718	40	92	652	1	500	298,228
1914	8,365	325,365	7,867,882	45	92	729	1	500	325,365

Similkameen Power Co.
Oroville, Wash.

L. L. Work, President.
Monroe, Harmon, Vice-President.
Chas. A. Andrews, Secretary.
C. C. Hedger, Manager, etc.
Transmission: 25 miles at 16,500 volts.
Distribution: 10 miles at 2200, 220 and 110 volts.

Eagle River Electric Power Co.
Baker City, Ore.

F. W. Paine, President.
J. K. Romig, Vice-Pres. & Gen. Mgr.
M. Boswell, Secretary.
Transmission: 60 miles, 22,500 volts.
Distribution: 2300 volts.
Capacity: 800 kw.

Idaho Power & Light Co.
Boise, Idaho.

L. L. Nunn, President.
E. P. Bacon, Manager.
J. C. Miller, Superintendent.
H. B. Waters, Electrical Engineer.
Transmission: 168 miles at 44,000 volts.
Distribution: 71 miles at 5000, 4000, 2300 and 110-220.

British Columbia Electric Railway Company, Ltd.

This company was incorporated in 1897, and immediately took over the operation of the electric tramways, light and power service in the district of British Columbia adjacent to the City of Vancouver, on the mainland, and adjacent to the City of Victoria, on Vancouver Island. On the mainland the installation known as the "Coquitlam-Buntzen" was first put into operation in 1904. By the end of the year 1910 the capacity of this plant had been increased to 16,000 kw., and the old reciprocating engines in the auxiliary steam plant had been superseded by modern steam turbines. tween that time and 1914 a new hydroelectric plant of 16,000 kw. capacity was installed at Jordan River, 40 miles west of Victoria. An auxiliary steam turbine plant of 4000 kw. capacity was also installed 12 miles from Victoria.

The growth of this system has been almost phenomenal. With but a single substation in 1900, the number had in 1914 increased to 35, and the mileage of transmission lines operated at over 11,000 volts, had increased from 32 in 1903 to 188 in 1914. This rapid growth, which has caused the company to increase its capital expenditures from $2,700,000 in

Power House No. 1 and No. 2, Lake Buntzen.

The years 1910 to 1914 marked a period of still further extensions. A new 64 mile interurban line from New Westminster to Chilliwas was completed and the capacity of plant No. 1, at Lake Buntzen, was increased to 21,000 kw. by enlarging the cross-section of the 12,775 ft. pressure tunnel, and the construction of a hydraulic fill dam 100 ft. in height at the southern end of Coquitlam Lake. During this time also Plant No. 2, at Lake Buntzen, with a capacity of 26,700 kw., was constructed.

On Vancouver Island the growth of the business kept pace with that on the mainland. The Gold Stream plant was put into operation in 1904 and had by 1910 reached an ultimate development of 2200 kw., and between 1898 to over $40,000,000 in 1914, can well be understood when it is considered that during this time the population of the territory they serve increased by almost 400 per cent.

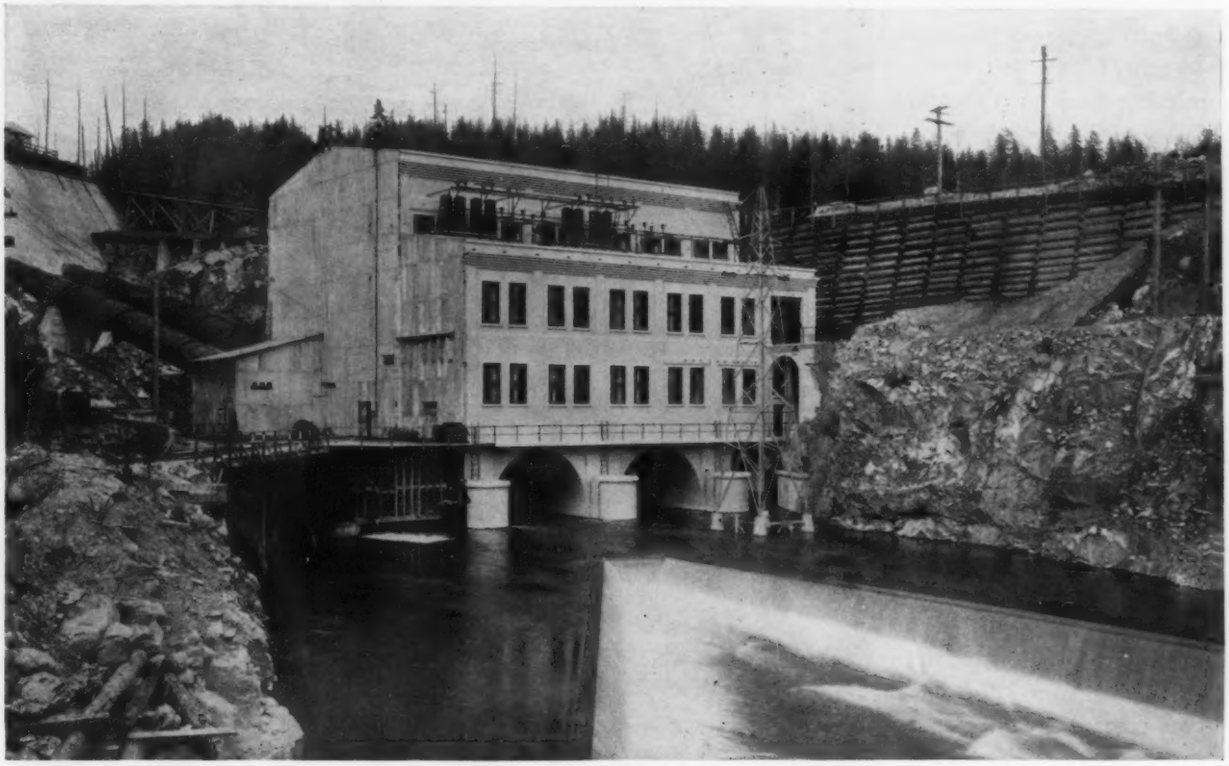
GROWTH OF BRITISH COLUMBIA ELECTRIC COMPANY, VANCOUVER, B. C.

Year.	Steam Kw. Hrs. Generated.	System Load Factor.	Miles H. T. Transmission.	Miles Overhead Distr.	Plants Installed Hydro. No.	Kw.
1905		29.2%	32	12	2	6,700
1906		31.2	42	12	2	8,200
1907		34.1	54	12	2	2,200
1908		35.7	54	12	2	13,000
1909		35.2	54	12	2	13,000
1910	17,336,990	37.7	171	19	2	18,000
1911	30,856,000	42.0	176	26	2	27,000
1912	39,066,815	44.6	168	48	3	31,000
1913	18,262,052	43.1	194	63	4	40,000
1914	350,024	45.0	188	66	4	65,900

Western Canada Power Company, Limited.

The Western Canada Power Company, Limited, was formed in 1909 for the purpose of furnishing power for industrial purposes in Vancouver and vicinity. In June of that year the company took over the property and franchises of the Stave Lake Power Company, Limited, and by January 1, 1912, was delivering power into Vancouver over a 35 mile transmission line at 60,000 volts from the Stave Falls plant at Ruskin, B. C.

The initial installation at this place consisted of two 10,000 kw. units, with an ultimate development of 40,000 kw. In addition to this station the general plan contemplates the use of this same water again through another power house that will give an additional 30,000 kw.



Stave Falls Plant, Western Canada Power Company.

GROWTH OF WESTERN CANADA POWER CO., LIMITED, VANCOUVER, B. C.

Year.	No. of Electric Consumers.	System Load Factor.	Miles H. T. Transmission.	Miles Overhead Distr.	Plants Installed. Hydro. No.	Kw.
1913	1,278	46%	55	167	1	20,000
1914	1,190	52	55	170	1	20,000

C. H. Cahan, President.
T. J. Drummnod, Vice-President.
O. B. McCallum, Secretary-Treasurer.
R. J. Hayward, General Manager.
Transmission: 55 miles at 60,000 volts.
Distribution: 115 and 220 volts.

Puget Sound Traction, Light & Power Company.

The system of the Puget Sound Traction, Light & Power Company represents the consolidation of the Puget Sound Power Company, the Seattle-Tacoma Power Company, the Seattle Electric Company, the Snoqualamie Power Company, and the Pacific Power Company.

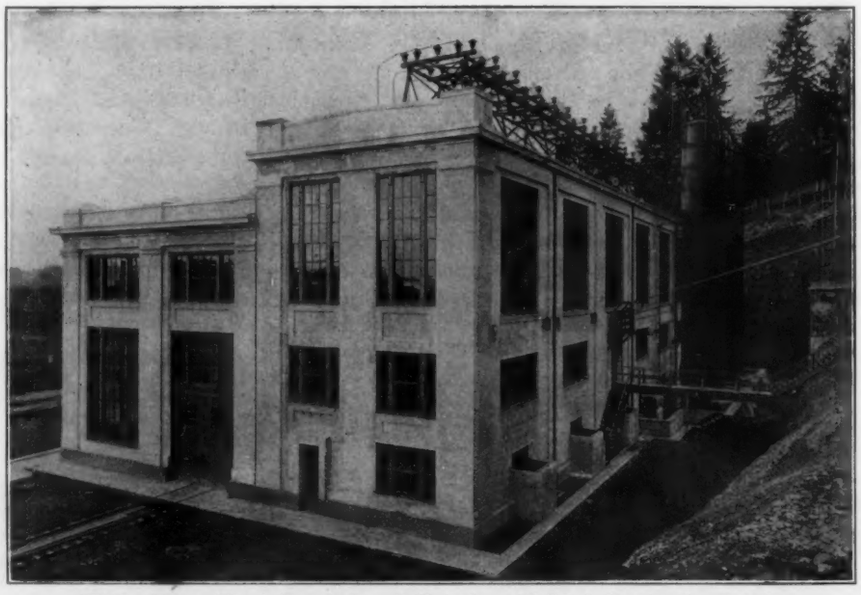
The early development of the hydroelectric industry in Western Washington began in 1899, when the Snoqualamie Power Company put into operation their 7000 kw. plant at Snoqualamie Falls, and began transmitting power to Seattle, a distance of 35 miles. Prior to this time the Puget Sound cities were dependent for their supply of electrical energy on steam generating stations—typical old-timers, with their horizontal engines, Edison type bi-polar generators and intricate mazes of belting and line shafting.

After the California and Oregon hydroelectric developments had shaped themselves so successfully, the numerous water power possibilities of this section assumed a new and greater importance. The first and perhaps the most important development of this company was the Snoqualamie Falls plant, where advantage was taken of a sheer drop of 270 ft. in the Snoqualamie River. The conditions to be met here were in many respects similar to those at Niagara Falls, and the same general plan of installing the electrical equipment underground has been carried out. The original installation of 7000 kw. has since been increased until now there is in successful operation, 270 ft. below the surface of the ground, a cavern generating station of 22,000 kw. capacity.

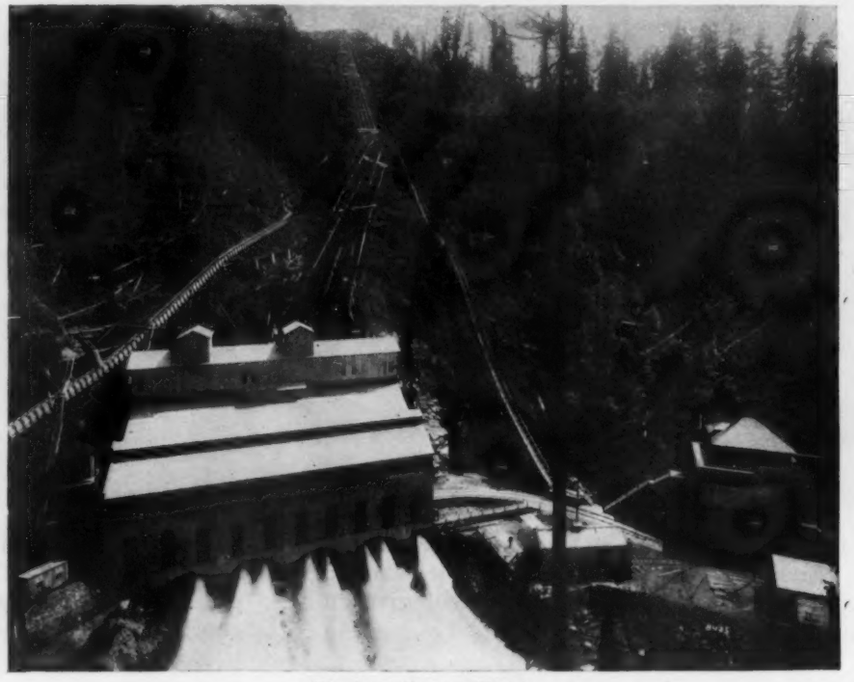
The transmission line from this plant to Seattle was originally constructed for 30,000 volts, but in 1909 it was rebuilt for 55,000 volts.

The Electron plant on the Puyallup River has an installed capacity of 22,000 kw., and was first put into operation in 1904, supplying power over a 48 mile, 55,000 volt transmission line to Tacoma. Subsequently another line was built to Seattle.

In November, 1911, the White River plant, located about midway between Seattle and Tacoma, was put into service, with an initial installation of 20,000 kw. From this station eight 55,000 volt circuits carried on steel towers deliver energy into the same general network of high tension lines as do the Snoqualmie and Electron plants. In addition to the hydroelectric stations this company operates two reserve steam plants in Seattle. The Post Street station in which is installed two 2250 kw. generators, driven by vertical type engines, was constructed in 1902. In 1908 the second station, containing a 16,000 kw. turbine, was constructed.



White River Plant Puget Sound Traction, Light & Power Company.



Electron Power House.

F. S. Pratt, Chairman of Board.
A. W. Leonard, President.
W. H. HcGrath, Vice-President.
C. M. Clark, Secretary.
H. B. Sawyer, Treasurer.
A. L. Kempster, Manager at Seattle.
L. H. Bean, Manager at Tacoma.
D. C. Barnes, Manager at Everett.
L. R. Coffin, Manager at Bellingham.

Transmission: 553 miles at 60,000 volts.
Distribution: 1070 miles at 13,000, 6600, 2300 volts.
Connected Load: 20,750 kw. residence lighting, 18,100 kw. commercial lighting, 45,500 kw. industrial power, 250 kw. agricultural power, 29,000 kw. electric railway.
Invested Capital: $70,000,000.
In its industrial department this company has introduced a novel feature. New industries are induced to locate in the territory served by the company, data of interest to prospective or present manufacturers is collected and supplied to interested parties.

GROWTH OF PUGET SOUND TRACTION, LIGHT & POWER COMPANY.. SEATTLE, WASH.

Year.	No. of Electric Consumers.	Light and Power Gross Electric Revenue.	Steam Kw. Hrs. Generated.	System Load Factor.	Miles H.T Transmission.	Miles Overhead Distr.	Plants Installed. Hydro. No.	Hydro. Kw.	Steam. No.	Steam. Kw.	*Gross Revenue All Depts.
1912	22,894	$1,933,824	205,500	50.0%	295	...	3	55,000	2	20,500	$6,729,996
1913	24,612	1,908,108	66,700	49.2	347	...	3	55,000	2	20,500	6,844,767
1914	26,046	1,830,416	4,200	50.0	370	425	3	55,000	2	20,500	6,917,910

*The above figures for Gross Revenue show the income from every source, including electric sales, street railways, etc.

Pacific Power & Light Company.

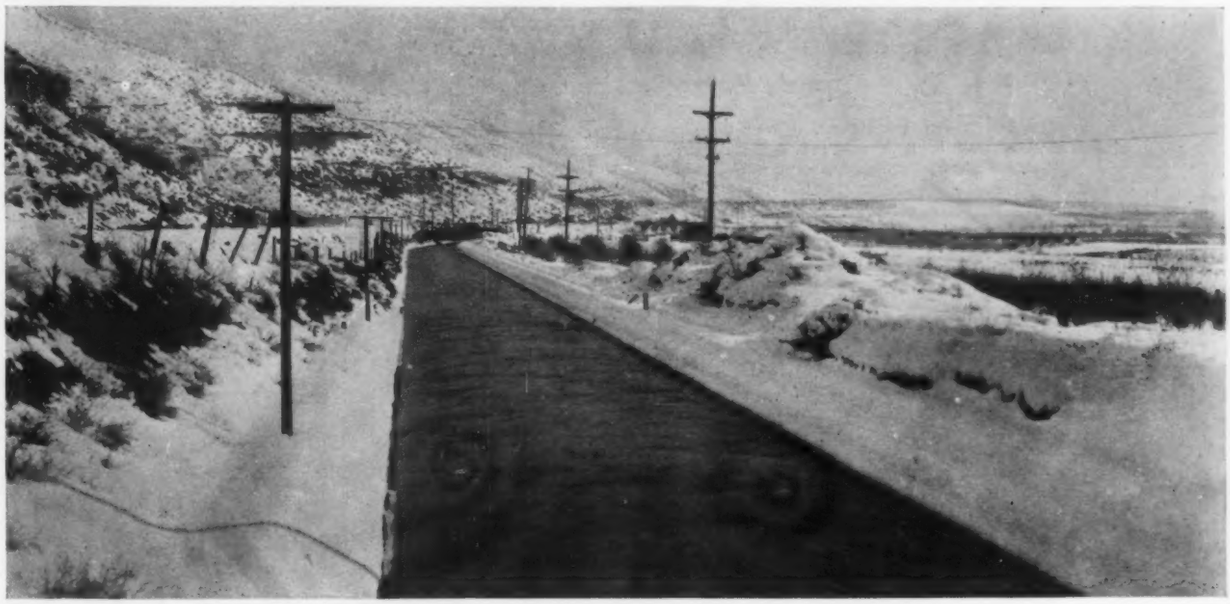
The Pacific Power & Light Company was incorporated in 1910 as a consolidation of a number of small power companies, operating in Southern Washington and Oregon, including the Walla Walla Gas & Electric Company, whose original plant was put into operation in 1892, at a time when this five mile transmission was considered remarkable. Other plants owned by this company are those at North Yakima, Prosser and Tygh Valley, having an aggregate capacity of 13,400 kw. They also have under construction at the present time the drop plant at Naches, Washington, which, when completed, will give an additional 1400 kw.

GROWTH OF PACIFIC POWER AND LIGHT COMPANY, PORTLAND, OREGON.

Year.	No. of Electric Consumers.	Kw. Hrs. Generated. Hydro.	Steam	System Load Factor.	Miles H. T. Trans-mission.	Miles Overhead Distr.	Plants Installed. Hydro. No.	Kw.	Steam. No.	Kw.	Gross Revenue All Depts.
1912	13,952	33,305,140	3,043,630	....	444	679	10	10,400	5	4,900	$789,136
1913	15,285	36,128,103	3,612,240	47.5%	444	749	10	13,400	5	4,900	827,872
1914	16,572	39,001,288	3,714,999	43.0	476	777	10	13,400	5	4,900	905,816

✓Guy W. Talbot, President.
J. E. Davidson, Vice-Pres. & Gen. Mgr.
Geo. F. Nevins, Sec. and Asst. Treas.
Lewis A. McArthur, Asst. Gen. Mgr.
J. H. Siegfried, Supt. of Power.
J. C. Martin, Engineer.
C. H. Still, Purchasing Agent.

Transmission: 476 miles at 25,000 and 66,000 volts.
Distribution: 777 miles at 2300 and 600 volts.
Connected Load: 27,275 kw. in Oregon, Washington and Idaho, of which 5000 h.p. supplied to irrigation motors.
Bonds: $7,166,000.



Main Power Canal Pacific Power & Light Company.

Eastern Oregon Light & Power Company.

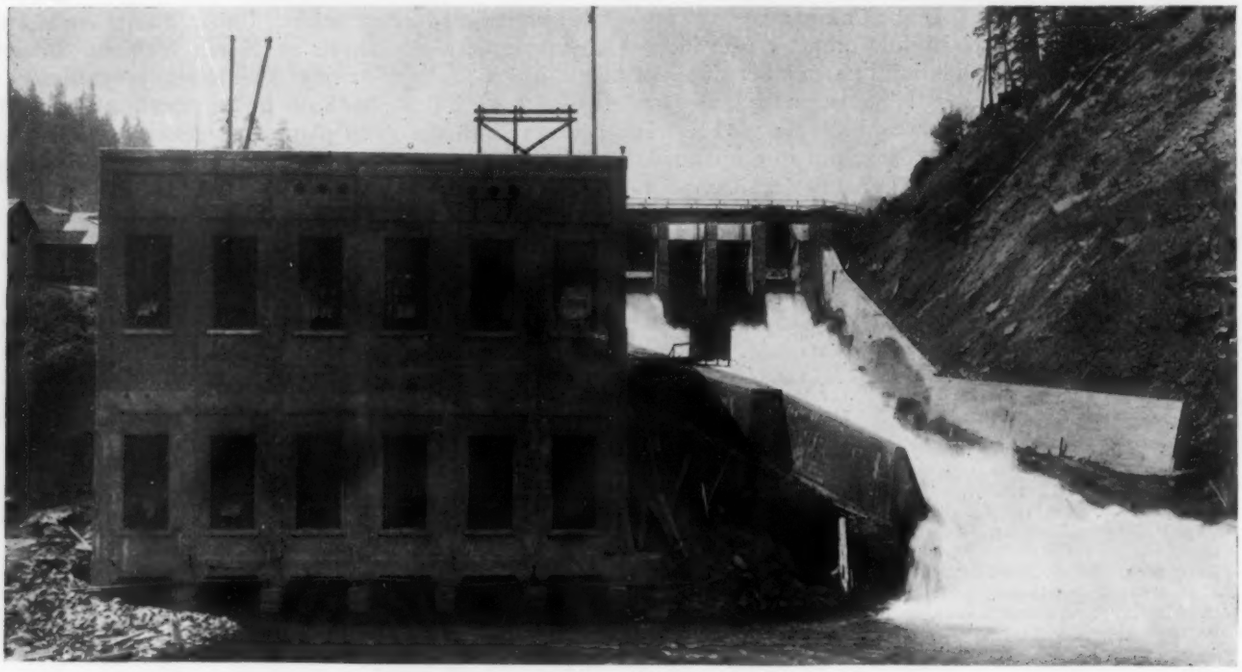
Baker City, Ore.

Ray Nye, President.
John S. Rand, Vice-President.
Transmission: 160 miles at 23,000 volts.
Distribution: 85 miles at 2300 volts.
Connected Load: 1375 kw. residence lighting, 812 kw. commercial lighting, 2618 kw. industrial power, 220 kw. agricultural power.

Northern Idaho & Montana Power Co.

Sandpoint, Idaho.

H. M. Byllesby, President.
A. S. Huey, Vice-President.
R. J. Trof, Secretary.
J. J. O'Brien, Treasurer.
Geo. N. Rooker, Manager.
Transmission: 30 miles at 66,000 volts, 8 miles at 11,000 volts.
Distribution: 20 miles at 2300 volts.
Connected Load: 1260.3 kw. lighting, 516 industrial and agricultural power.

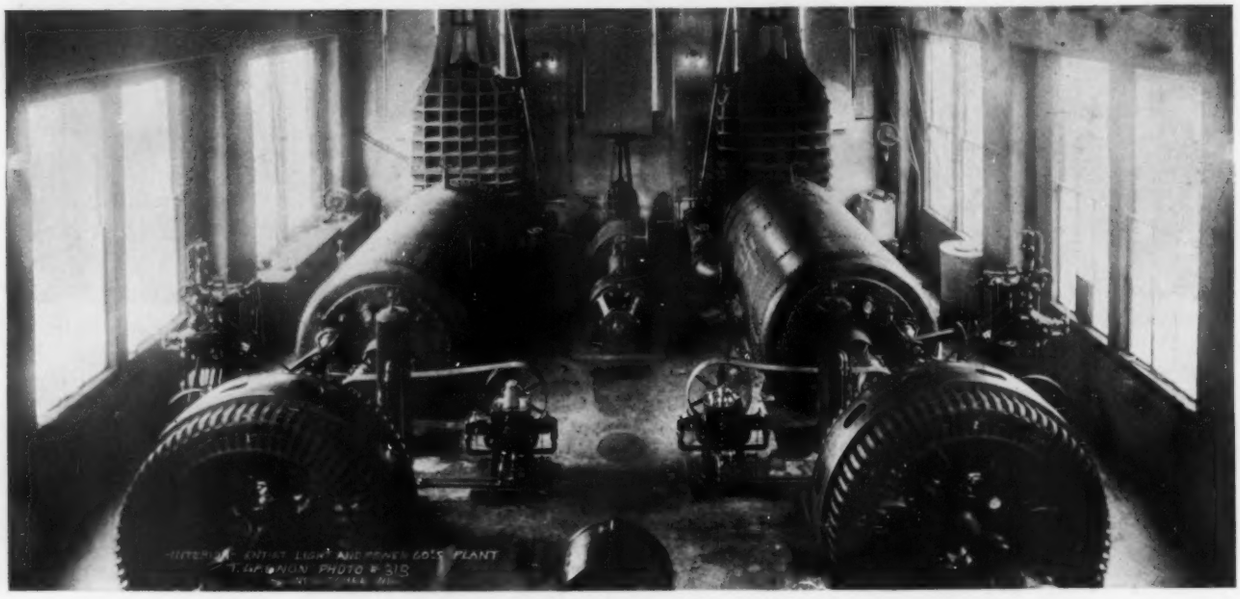


Elwa Plant Olympic Power Company.

Olympic Power Co., Port Angeles, Wash.

Geo. A. Glines, President.
Thos. T. Aldwell, Vice-Pres. & Gen. Mgr.
Jas. A. Kerr, Secretary.
C. L. Haggith, Treasurer.
F. D. Nims, Asst. Mgr. & Elec. Engr.

Transmission: 93.7 miles at 66,000 volts.
Distribution: 10.5 miles at 6600 volts.
Connected Load: 5343 h.p.—wholesale only—to other utilities.
Invested Capital: $2,270,000.



Entiat Plant Wenatchee Gas & Electric Company.

Wenatchee Valley Gas & Electric Co., Wenatchee Valley, Wash.

Arthur Gunn, President and Manager.
Geo. D. Brown, Vice-President.
Fred M. Crollard, Secretary.
R. C. Kennedy, Treasurer.
W. R. Thomas, Sup. and Elec. Engineer.

Transmission: 65 miles at 33,000 and 16,500 volts.
Distribution: 250 miles at 2200 volts.
Connected Load: 1600 kw. lighting, 800 kw. industrial power, 1800 kw. irrigation.
Invested Capital: $1,600,000.

Power Plant of Lewiston-Clarkston Company.

Lewiston-Clarkston Improvement Co., Clarkston, Wash.

Robt. A. Foster, President.
Henry Adams, 2d Vice-President.
Geo. W. Bailey, Secretary.
W. R. Echternach, Treasurer.
Robt. A. Foster, Manager.
John J. Jennings, Superintendent.
P. P. Oehler, Engineer.
W. R. Echternach, Purchasing Agent.

Transmission: 31 miles at 22,500 volts.
Distribution: 100 miles at 2200 volts.
Connected Load: 1200 h.p. residence lighting, 930 h.p. commercial lighting, 1580 h.p. industrial power, 150 h.p. agricultural power, 150 h.p. electric railway.
Invested Capital: $747,307.

The Montana Power Co.(Con.)

Butte, Mont.

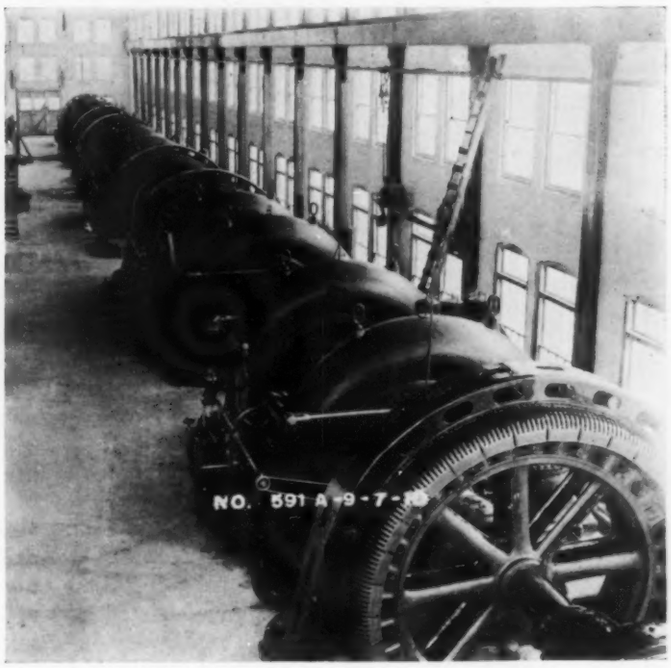
John D. Ryan, President.
Max Hebgen, Vice-President.
Walter Dutton, Secretary.
Walter Dutton, Treasurer.
Max Hebgen, General Manager.
Frank M. Kerr, Superintendent.
H. H. Cochrane, Electrical Engineer.
W. T. Jackson, Purchasing Agent.

Transmission: 1470 miles at 10,000 to 110,000 volts.
Distribution: 450 miles at 110 to 10,000 volts.
Connected Load: 11,000 kw. residence lighting, 10,355 kw. commercial lighting, 105,830 kw. industrial power, 1350 kw. agricultural power, 7500 kw. electric railway.
No. of consumers, 26,292.

Grangeville Electric Light & Power Co.

Grangeville, Idaho.

Eugene Enloe, Pres., Mgr. & Pur. Agent.
W. S. Sivyer, Secretary-Treasurer.
T. E. Bayless, Superintendent.
Transmission: 22,000 volts.
Distribution: 220, 110 volts.
Generating Capacity, 875 kw.
Capital Stock: $229,700.



Rainbow Plant Montana Power Company.

DEVELOPMENTS IN CALIFORNIA.

Pacific Gas & Electric Company.

The system of the Pacific Gas & Electric Company represents the consolidation of a number of independent companies operating in the central part of California.

The oldest hydroelectric plant of the system is the one at Folsom, on the American River, installed by the Folsom Water Power Company. This was first put into operation on September 9, 1895, supplying power over a 22 mile, 11,000 volt line to Sacramento. The installation consisted of four 750 kw., 3 phase, 800 volt, 60 cycle armature type General Electric generators, direct connected to Sampson turbines, operating at 300 r.p.m. under a 55 ft. head. The generators, at the time they were installed, were the largest that had ever been built, and although they are of a type that is now considered obsolete, it is interesting to know that they are still operating as satisfactorily as they ever did.

In 1905 the voltage of the line between Folsom and Sacramento was increased to 60,000 by reconstructing one of the four 11,000 volt circuits for the higher voltages, and salvaging the other three.

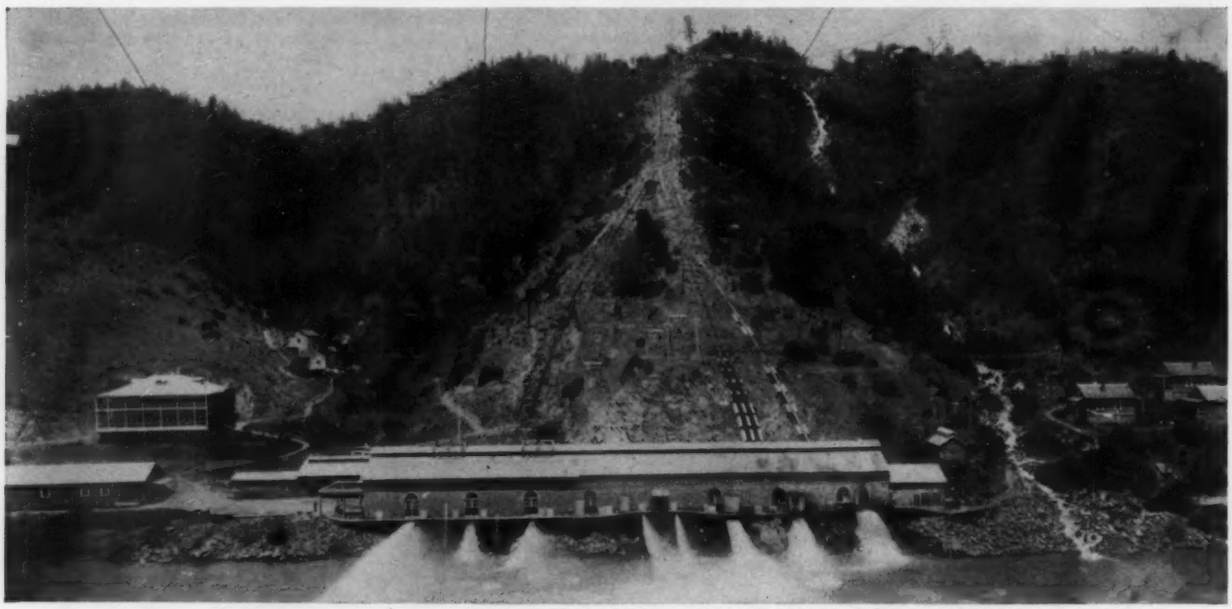
In 1897 the Blue Lakes Water Company installed the Blue Lakes plant. This installation consisted of four 450 kw., 2300 volt 60 cycle, 2 phase Stanley inductor type generators, direct connected to Doble impulse water wheels, operating at 600 r.p.m., under a 1040 ft. vertical head. This plant marked a step forward in the design of high head plants in that two bearing units having overhung water wheels were used for the first time.

It was expected that a ready market for electric power would be found among the mines along the "Mother Lode," but the miners were slow to adopt the new power, and in 1900, after the Standard Electric Company took over the property, the line was extended to Stockton, a distance of 49 miles, and the voltage raised from 10,000 to 30,000. About this same time the construction of the Electra plant was started. This new plant contemplated using the water of the Blue Lakes plant at a considerably higher head, with the result that the Blue Lakes plant was abandoned.

The original Electra installation consisted of five 2000 kw., 2300 volt, 60 cycle, Stanley inductor type generators, direct connected each to two Pelton impulse water wheels operating under a 1466 ft. head at 240 r.p.m.

In 1905 two additional 5000 kw. units operating under a 1266 ft. head were installed. In 1901 the 30,000 volt line to Stockton was rebuilt for 60,000 volts, and extended to Oakland, giving a total length of line of 150 miles.

In 1898 the Yuba power house, with a capacity of 990 kw. was built for supplying power to the town of Marysville, 23 miles away. This was a record-breaking installation, as the entire work was completed and the plant put into operation within four months and five days after its building had been determined upon. Immediately following the completion of this plant the construction of the Colgate plant for supplying power to Sacramento was commenced. This was completed in 1899. The original installation consisted of three 900 kw., 2300 volt, 60 cycle Stanley inductor type generators. The voltage was stepped up to 40,000 and transmitted over a double circuit solid aluminum line 76.3 miles to Sacramento. At the time this was the longest transmission line in the world, and as illustrating the great demand for electric power, it is interesting to know that the station was put into operation and fully loaded before it was completed. In 1901 the capacity was increased by the installation of



Colgate Plant, Pacific Gas & Electric Company.

three 2000 kw. generators of the same voltage and type as the 900's, and two 60 kv. transmission lines extended to Oakland, a distance of 142 miles. In 1907 another unit of 5500 kw. was installed, thus giving a present installed capacity of 14,200 kw.

The Centerville plant was built in 1900 for supplying power and lighting service in the town of Chico and power for the gold dredgers working in the Feather River near Oroville. The two original 400 kw. Westinghouse armature type generators were replaced in 1907 by a 5500 kw. 2300 volt, 60 cycle Stanley machine, direct connected to a Francis turbine operating under a 577 ft. head. The present capacity of this plant is 6400 kw.

The de Sabla plant, with an initial installation of two 2000 kw. units, was first put into operation in 1903. This was increased in 1904 by the addition of a 4000 kw. unit, and again in 1906 by a 5000 kw. unit, thus giving a total present capacity of 13,000 kw. The two 2000 machines are 2300 volt inductor type, the larger units being for the same voltage, but of the rotating field type.

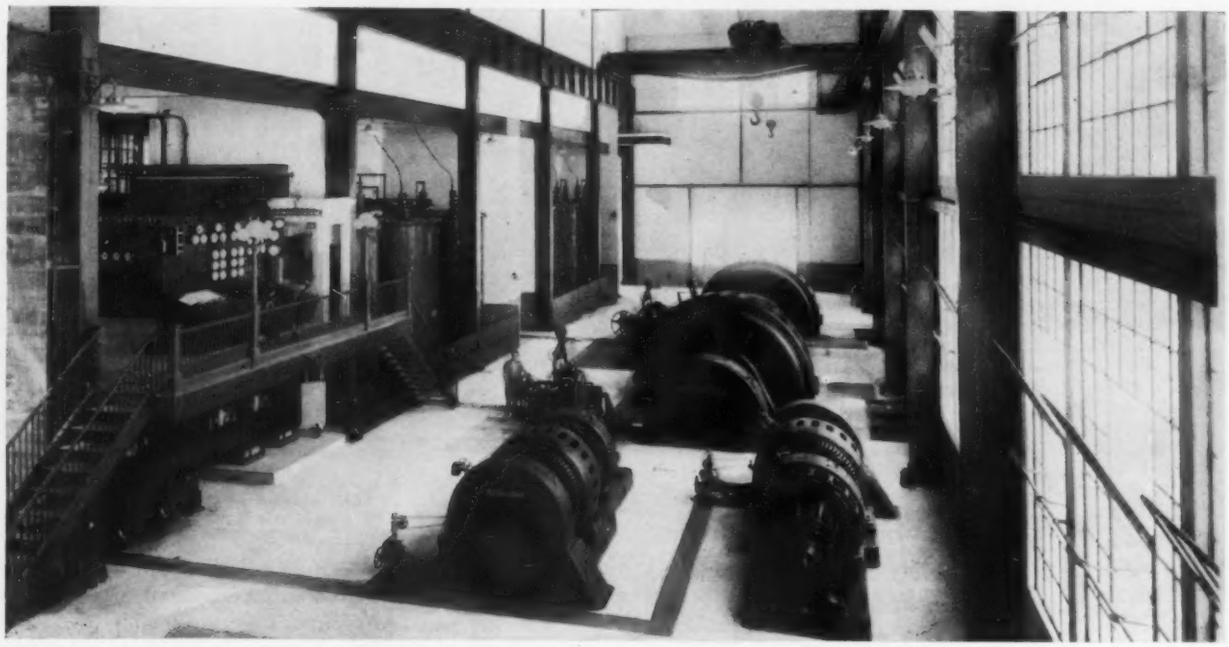
The Drum plant is the largest and most modern hydroelectric plant owned by this company, it having been completed and put into operation in November, 1913. It has a present capacity of 25,000 kw., but by the installation of a second pipe line and two more units its capacity can be increased to 50,000 kw.

The transmission line to Cordelia, the center of the present 60,000 volt network, operates at 110,000 volts. Except for the first twelve miles, which runs through a country subject to heavy snows, and where single circuit towers with the conductors placed in a horizontal plane were used, double circuit steel towers spaced 800 ft. apart have been used.

The other older and less important plants owned by this Company are Deer Creek, with 5500 kw. capacity; Alta, with 1000 kw. capacity, and Newcastle, with 800 kw. capacity. At each of these stations advantage is taken of the natural fall in the canals or ditches carrying water for other purposes, and the generation of electric power is, therefore, incidental.

In addition to the ten hydroelectric plants with an aggregate of 90,310 kw., this company has four reserve steam plants located in the more important cities it supplies. The San Francisco station has installed 53,500 kw.; Oakland, 21,000 kw.; Sacramento, 5000 kw., and San Jose 2200 kw., making a total of 81,700 kw. The first steam turbine installation was made in 1910.

The transmission system of this company consists of 1534 miles of high tension lines, all of which, with the exception of the main tower line from Drum power house to Cordelia, and a few unimportant branch lines, are operated at the uniform voltage of 60,000.



Interior Drum Power House, Pacific Gas & Electric Company.

GROWTH OF PACIFIC GAS & ELECTRIC COMPANY, SAN FRANCISCO, CAL.

Year.	Lightand Power No. of Electric Consumers.	Gross Electric Revenue.	†Kw.-Hrs. Generated. Hydro.	Steam.	System Load Factor.	Miles H. T. Trans-mission.	Miles Overhead Distr.	Plants Installed. Hydro. No.	Hydro. Kw.	Steam. No.	Steam. Kw.	*Gross Revenue All Depts
1907	54,772	$6,316,629	272,025,310	72,958,780	.....	....	....	10	64,600	7	39,000	$11,342,140
1908	62,026	7,059,988	284,404,696	89,646,895	.....	....	....	11	69,100	7	39,000	12,657,304
1909	70,515	7,678,665	255,361,874	67,748,939	58.2%	....	....	11	69,100	5	45,000	13,491,288
1910	83,005	7,899,224	193,501,609	72,029,947	61.2	....	....	11	69,100	4	33,000	14,044,595
1911	102,024	7,823,903	246,065,829	83,047,540	57.3	1319	2233	11	69,100	4	43,400	14,604,602
1912	117,065	7,672,570	244,114,227	78,198,070	57.1	1371	2815	9	67,200	4	70,000	14,744,652
1913	132,355	8,230,582	239,228,562	115,244,960	59.0	1531	3484	10	92,310	4	81,700	16,202,337
1914	148,957	8,759,449	374,957,993	101,639,560	60.6	1534	3685	10	90,310	4	81,700	17,220,504

*The above figures for Gross Revenue show the income from every source as electric sales, gas, street railways and water systems.

†This company also purchases a considerable amount of power from other companies.

Spaulding Dam and Reservoir.

Pacific Gas & Electric Company

San Francisco, California

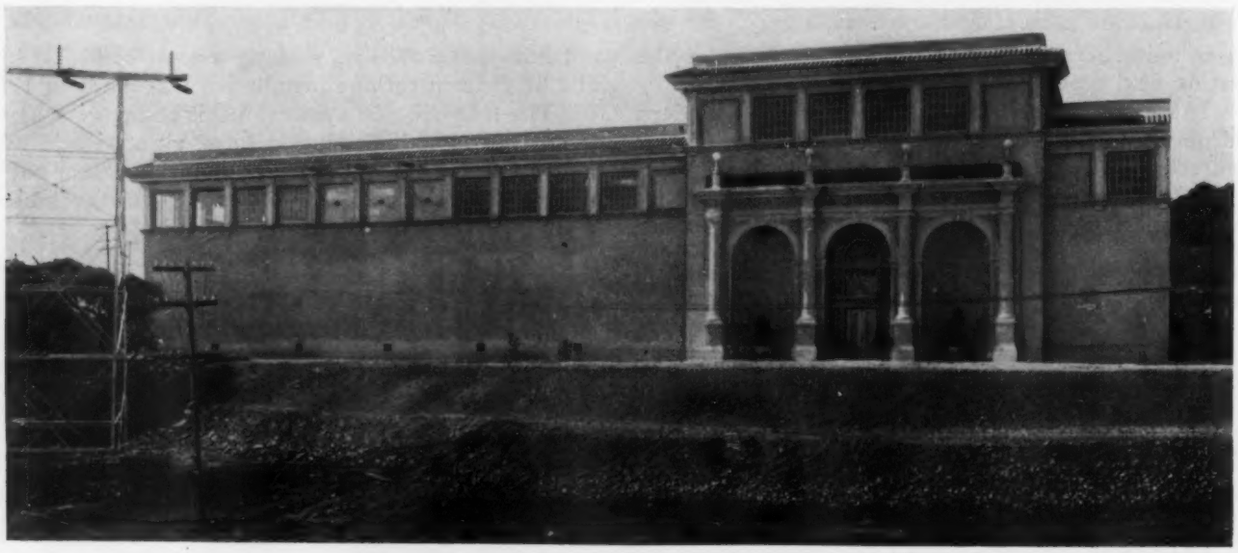
F. G. DRUM.....President
JOHN A. BRITTON.....Vice-President and General Manager
A. F. HOCKENBEAMER...Second Vice-President and Treasurer
J. E. GLADSTONE.....Third Vice-President
D. H. FOOTE.....Secretary and Assistant Treasurer
JOS. C. LOVE.....Assistant Treasurer
CHAS. L. BARRETT.....Assistant Secretary
RALPH W. HALSEY.....Assistant Secretary

Heads of Departments

W. B. BOSLEY.....Attorney
M. H. BRIDGES.....Auditor
R. J. CANTRELL.....Property Agent
J. P. COGHLAN.....Manager Claims Dept.
P. M. DOWNING..Chief Engr. O. & M. Hydro-Elec. Dept.
E. B. HENLEY.....Manager Land Dept.
JNO. H. HUNT.....Purchasing Agent
J. P. JOLLYMAN.....Engineer Electrical Construction
E. C. JONES.....Engineer Gas Dept.
W. H. KLINE.....General Agent
S. J. LISBERGER.....Engineer Electrical Distribution
F. S. MYRTLE.....Manager Publicity Dept.
L. H. NEWBERT.....Manager Sales Dept.
GEO. C. ROBB.....Superintendent of Supplies
F. H. VARNEY....Engineer O. & M. Steam-Elec. Dept.
H. C. VENSANO.....Civil and Hydraulic Engineer
W. G. VINCENT, JR.....Valuation Engineer
S. V. WALTON.....Manager Commercial Dept.

"Pacific Service" Represents

4,648 employees in all departments.
$125,000,000.00 capital invested in gas, electricity, railroads and water plants.
38,000 square miles of territory in which it operates.
6,243 men and women as stockholders, of whom
1,630 employees are stockholders.
30 counties of the State in which it transacts business.
380,000 consumers served with gas, electricity, water and steam.
1,200,000 people served in 30 counties.
177 cities and towns in which it transacts business.
$5,300,000.00 annual wages paid employees in 1914.
$3.07 average daily wage paid each employee in 1914.
$12,141,500.00 expended in 1914 in California for labor and material
$722,994.00 taxes paid to the State of California in 1914.
120,000 horsepower developed in 10 electric water-power plants.
110,000 horsepower developed in 4 electric steam plants.
230,000 total horsepower developed in 14 plants.
7,600,000,000 cubic feet of gas sold in 1914.
17 gas plants.
19,000 miles of wire used in distributing electricity.
2,500 miles of mains used in distributing gas.
700 miles of mains and ditches used in distributing water.
600 miles of tracks of street railways operated and supplied with power.
40,000,000,000 gallons of water stored in 62 lakes.
44,000 acres of land owned in California.
1,812,582 barrels of California oil used in 1914.
50,000 horsepower in agriculture depending on "Pacific Service."
155,000 horsepower in industrials depending on "Pacific Service."
33,000 street lamps, gas and electric, lighted by "Pacific Service."
3,000,000 incandescent lamps nightly lighted.
478,598 horsepower connected to system.

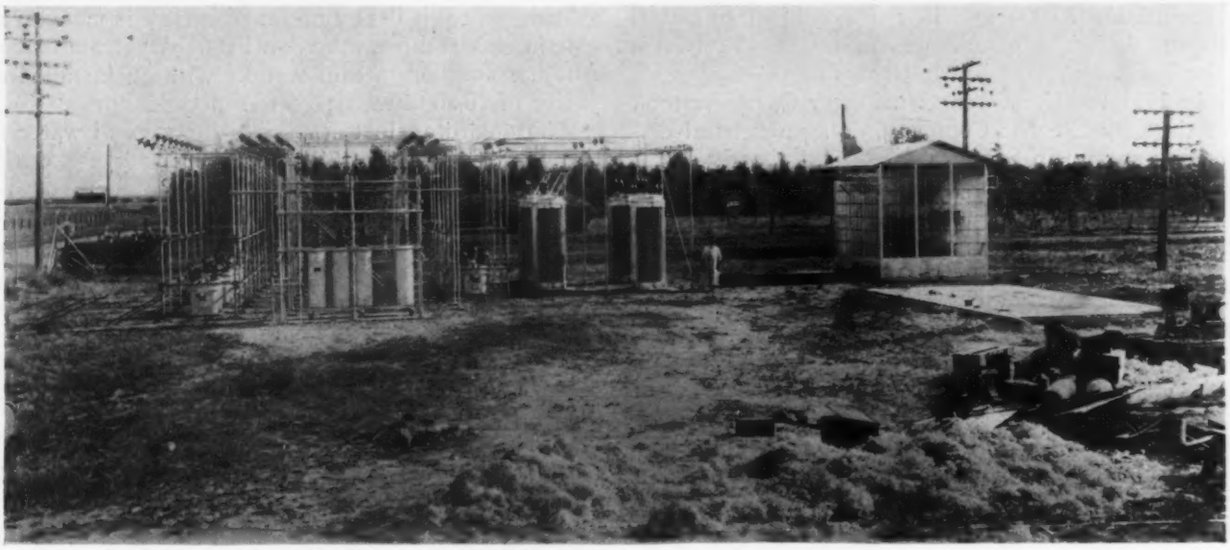


Cordelia Substation, Pacific Gas & Electric Company.

Mount Whitney Power & Electric Company.

The operations of the Mount Whitney Company date from June, 1899, when they first put into operation their Kaweah Plant No. 1, consisting of three 450 kw., 440 volt, 3 phase armature type Westinghouse generators.

The second installation, known as "Kaweah Plant No. 2," was made in 1905, and consisted of three 500 kw., 2300 volt, 3 phase General Electric generators, direct connected to Victor-Girard turbines. Shortly after this plant was put into operation two of these units were replaced by a 1500 kw. unit, direct connected to a Francis type of turbine.



Outdoor Substation Mt. Whitney Power & Electric Company.

Harris Hammond, President.
Ben. M. Maddox, Vice-President.
E. E. Baker, Secretary.
Patrick M. Longan, Treasurer.
A. J. Robertson, Supt. of Production.
F. G. Hamilton, Supt. of Distribution.
F. G. Hamilton, Purchasing Agent.

Transmission: 179 miles at 33,000 volts.
Distribution: 1035 miles at 2200 and 6600 volts.
Connected Load: 1941.02 kw. residence lighting, 789.87 kw. commercial lighting, 1644 kw industrial power, 8391.88 kw. agricultural power, 805.68 kw. electric railway.
Invested Capital: $5,662,910.

Kaweah Plant No. 3, the next to be constructed, consisted of two 1750 kw., 2300 volt, 3 phase Westinghouse generators, direct connected to Pelton Doble impulse wheels, operating under a head of 776 ft.

The last installation of this company, known as "The Tule power house," contains two 1000 kw., 2300 volt, General Electric generators, driven by Doble wheels, operating under an 1130 ft. head.

A very large part of the load of this company, particularly during the summer months, consists of small irrigation pumps used in the citrus groves along the foothills of the Sierras. An auxiliary steam station having a capacity of 6750 kw. is located at Visalia.

Great Western Power Company.

The Western Power Company of California was organized in 1901, but it was not until 1906 that the Great Western Power Company of California, the present operating company, was organized and took over the reservoir sites and water rights of the former company. Development of the property was at once begun, and in December, 1908, four 10,000 kw. generators at Big Bend were placed in operation.

The early day miners in search for gold diverted the water of the Feather River through a tunnel 15,000 ft. long, and in this way were able to work, approximately, 10 miles of the natural bed of the river. The difference in elevation between the point where the water was diverted from the river, and where it was returned to the river is 450 ft., and it is this head that the Great Western Power company utilizes.

The tunnel as originally constructed was enlarged, lined with concrete, and is now a part of the pressure line to the Big Bend power house. The power house equipment consists of four 10,000 kw. and one 800 kw. General Electric 3 phase, 11,000 volt vertical type generators, each direct connected to Francis type turbines.

Energy is delivered to Sacramento and Oakland at 100,000 volts over a double circuit steel tower line, having a total length of 155 miles. At the latter place,

GROWTH OF MT. WHITNEY POWER & ELECTRIC COMPANY.
VISALIA, CAL.

Year.	Light and Power No. of Electric Consumers.	Gross Electric Revenue.	Steam Kw.-Hrs. Generated.	System Load Factor.	Miles H.T. Trans-mission.	Miles Overhead Distr.	Plants Installed. Hydro. No.	Hydro. Kw.	Steam. No.	Steam. Kw.	Gross Revenue All Depts.
1903	710	$ 89,392	.....	....	60	46	1	1,350			$ 92,630
1904	820	101,137	.....	....	61	73	1	1,350			104,185
1905	990	117,882	.....	....	61	88	2	2,850			120,917
1906	1,297	140,585	.....	....	61	117	2	3,350	1	1,000	146,568
1907	1,438	175,048	18,350	....	62	129	2	3,350	1	1,000	182,473
1908	2,056	229,339	1,227,570	....	66	167	2	3,350	1	1,000	233,703
1909	2,850	271,954	363,590	....	82	221	3	5,300	1	1,000	279,839
1910	3,367	325,649	217,910	....	169	390	3	5,300	1	1,000	334,977
1911	3,886	380,529	47,630	....	169	462	3	5,300	1	1,000	388,940
1912	4,464	436,189	2,164,796	53%	170	562	3	5,300	1	1,750	445,825
1913	5,367	551,450	1,866,600	49	171	738	4	8,850	1	1,750	562,852
1914	5,811	638,215	1,682,100	56	179	1035	4	8,850	1	6,750	643,728

Lake Almanor. Storage Reservoir of Great Western Power Company.

approximately 15,000 kw. is stepped down to 60,000 volts and delivered into the general 60,000 volt system of the Pacific Gas & Electric Company.

In 1911 the Great Western Power Company took over the City Electric Company, doing a general distributing system in San Francisco, and shortly thereafter laid a 11,000 volt, 3 phase submarine cable across San Francisco Bay to connect with their hydroelectric system in Oakland. A second cable has since been laid, thus making available for their San Francisco distribution approximately 10,000 kw. of hydroelectric energy, or in the event of trouble on the hydroelectric system, an equivalent amount of energy is made available in Oakland from the San Francisco steam station. Another auxiliary steam station, with an installed capacity of 10,500 kw., is located in Oakland.

To guard against a possible shortage of water for the operation of the Big Bend power house during dry seasons, this company in 1914 constructed at Big Meadows, on the headwaters of the Feather River, one of the largest storage reservoirs in the state. An hydraulic fill earth dam 80 ft. high and 600 ft. long backs water up 10 miles, forming a lake having an area of 30 square miles, and an average depth of 15 ft.

GROWTH OF GREAT WESTERN POWER COMPANY.
SAN FRANCISCO, CAL.

Year.	Light and Power No. of Electric Consumers.	Light and Power Gross Electric Revenue.	Steam Kw. Hrs. Generated.	System Load Factor.	Miles H.T. Trans-mission.	Miles Overhead Distr.	Plants Installed. Hydro. No.	Hydro. Kw.	Steam. No.	Steam. Kw.	Gross Revenue All Depts.
1912	13,300	$2,298,000	60,640,000	66%	310	767	1	40,000	2	31,200	$2,300,334
1913	15,000	2,684,568	70,670,000	71	310	877	1	40,000	2	31,200	2,698,214
1914	17,000	2,664,204	31,790,000	65	310	955	1	52,500	2	31,200	2,681,990

Mortimer Fleishhacker, President.
Guy C. Earl, Vice-President.
H. P. Wilson, Vice-President.
F. M. Tompkins, Treasurer.
E. W. Beardsley, Superintendent.
John A. Koontz, Electrical Engineer.
Frank M. Smith, Purchasing Agent.

Transmission: 154 miles at 100,000 volts.
Distribution: 800 miles at 22,000-11,000 volts and lower.
Connected Load: 175,000 h.p.
The company serves 17,000 customers in 11 counties in the central portion of the state. Operates the largest hydroelectric power house on the Pacific Coast, 75,000 h.p. Operates Lake Almanor storage reservoir, the largest artificial lake in the state of California. Area of 30 square miles containing 250,000 acre feet of water. Total available hydroelectric power developed and undeveloped, combined, 550,000 h.p.
Invested Capital: $50,000,000.

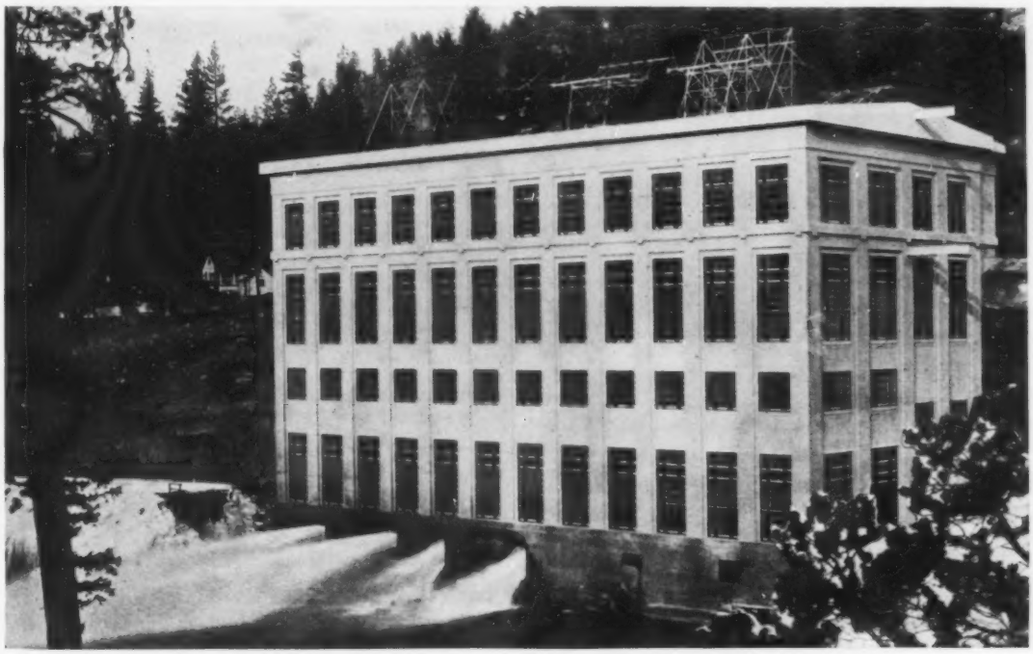
Big Bend Plant of Great Western Power Company.

Pacific Light & Power Corporation.

The Pacific Light and Power Corporation was organized in January, 1910, to take over the property of the Pacific Light & Power Company, which at that time was operating six hydroelectric generating stations, having a total rated capacity of 14,400 kw., and three steam generating stations, having a capacity of 41,500 kw.

Outside of the 10,000 kw. plant on Kern River, which is connected to a substation in Los Angeles by two 117 mile 50,000 volt transmission lines, all of the hydro generating stations are interconnected with a network of 15,000 volt distributing lines, and furnish power to the various cities and towns in Los Angeles, Riverside and San Bernardino Counties, as well as to irrigation and other consumers along the line.

The largest and most important installation of this company is the Big Creek project, started in 1911 and completed in 1913. The first step in this development has added to their system 60,000 kw. of hydroelectric energy, thus enabling them under average conditions to operate their steam plants only in cases of emergency. From power houses Nos. 1 and 2, in Fresno County, power is transmitted over a single circuit steel tower line at 150,000 volts, a distance of 241 miles to the city of Los Angeles.



Big Creek Plant Pacific Light & Power Corporation.

H. E. Huntington, President.
G. E. Ward, Vice-President.
W. E. Dunn, Vice-President.
O. V. Showers, Secretary.
A. N. Kemp, Treasurer.
E. R. Davis, Manager.
D. D. Morgan, Superintendent.
J. L. Hoke, Superintendent.
H. A. Barre, Electrical Engineer.
W. J. Gracey, Purchasing Agent.

Transmission: 482 miles at 150,000 volts, 105 miles at 60,000 volts, 223 miles at 50,000 volts.

Distribution: 550 miles at 15,000 volts, 1976 miles at 2400 volts and under. Frequency: 50 cycles.

Connected Load: 43,300 h.p. lighting, 38,928 h.p. industrial and agricultural power, 67,600 h.p. electric railway.

Invested Capital: $53,920,000.

GROWTH OF PACIFIC LIGHT & POWER CORPORATION, LOS ANGELES, CAL.

Year.	Light and Power Gross Electric Revenue.	Steam Kw.-Hrs. Generated.	System Load Factor.	Miles H. T. Trans-mission.	Miles Overhead. Distr.	Plants Installed. Hydro. No.	Hydro. Kw.	Steam. No.	Steam. Kw.
1900	$ 94,480	.....	..	...	....	5	2,900	.....	.....
1901	260,036	.....	..	...	....	5	2,900	.....	.....
1902	373,652	.....	..	...	....	5	2,900	.....	.....
1903	549,097	.....	..	...	....	5	2,900	.....	.....
1904	769,518	.....	..	...	....	7	14,400	.....	.....
1905	1,017,907	.....	..	...	....	7	14,400	.....	.....
1906	1,265,300	.....	..	...	....	7	14,400	.....	.....
1907	1,161,616	25,227,234	48%	...	....	7	14,400	2	.....
1908	1,545,738	83,626,548	48	...	....	7	14,400	2	.....
1909	1,649,176	86,792,479	50	254	1330	7	14,400	3	41,500
1910	1,878,844	108,364,450	48	254	1540	7	14,400	3	41,500
1911	2,117,728	139,462,369	52	254	1750	7	14,400	4	.....
1912	2,357,700	178,131,944	45	254	2014	6	14,300	4	.....
1913	2,632,040	184,841,511	48	800	2112	8	74,300	4	.....
1914	2,639,318	212,192,288	48	810	2526	8	74,300	3	.....

San Joaquin Light & Power Corporation.

The San Joaquin Light & Power Corporation was organized in 1902 for the purpose of taking over the holdings of the San Joaquin Light & Power Company, which during the six or eight years of its existence had become financially involved to such an extent as to go into bankruptcy. The old original plant of the San Joaquin Company, containing three 250 kw. machines, was placed in operation in 1896, and at the time was considered a remarkable development, due to the high head of 1425 ft., and also the distance power was transmitted. The transmission line ran to Fresno, a distance of 38 miles, and there supplied commercial light and power, but in 1900 it was extended on to Hanford, 24 miles away. In 1911 the plant was abandoned, and on the same site there was erected a new and larger plant, known as "San Joaquin No. 1," containing four 3200 kw. units.

In the meantime the company had acquired the 1350 kw. plant of the Power, Transit & Light Company, which had been installed in about 1897, and have since built the Tule plant, having a capacity of 2000 kw.

GROWTH OF SAN JOAQUIN LIGHT & POWER CORPORATION, FRESNO, CAL.

Year.	No. of Electric Consumers.	Light and Power Gross Electric Revenue.	Kw.-Hrs. Generated. Hydro.	Steam.	System Load Factor.	Miles H. T. Transmission.	Miles Overhead Distr.	Plants Installed Hydro. No.	Kw.	Gross Revenue All Depts.
1900	.....	$ 126,906	.....	.....	.....	78	113	2	3,000	$ 126,906
1901	.....	161,361	.....	.....	.....	78	136	2	3,000	161,361
1902	.....	210,603	.....	.....	.....	78	147	2	3,000	210,603
1903	.....	269,278	.....	.....	.....	78	164	2	3,000	269,278
1904	.....	280,493	.....	.....	.....	78	220	2	3,000	280,493
1905	.....	321,390	8,834,270	750,021	.....	150	220	2	3,000	321,390
1906	.....	370,457	10,446,100	515.692	48.1%	150	306	3	6,000	370,457
1907	.....	423,997	12,360,700	8,200	47.9	171	373	3	6,000	423,997
1908	 3,721	489,272	13,021,300	679,609	53.0	171	401	3	6,000	489,272
1909	 4,903	585,598	15,663,700	726,025	57.7	171	469	3	6,000	585,598
1910	 9,641	720,636	19,127,400	2,002,763	42.6	421	603	3	12,000	720,636
1911	12,567	849,733	42,571,830	2,583,840	51.5	503	946	3	18,300	849,733
1912	15,910	1,108,952	67,048,400	3,565,800	53.3	606	1226	3	18,300	1,108,952
1913	18,577	1,455,461	53,655,130	42,039,735	55.7	704	1697	3	18,300	1,455,461
1914	19,934	1,568,197	106,828,450	1,093,903	64.0	704	1770	4	27,800	1,568,187

W. G. Kerckhoff, President.
A. C. Balch, Vice-President.
L. M. Farnham, Secretary.
A. E. Peat, Treasurer.
A. G. Wishon, Manager.
E. A. Quinn, Superintendent.
J. H. Newlin, Purchasing Agent.

Transmission: 704 miles at 60,000 volts.
Distribution: 1770 miles at 10,000, 4000, 2300 volts.
Connected Load: 9023 kw. residence lighting, 7991 kw. commercial lighting, 26,032 h.p. industrial power, 8566 h.p. agricultural power, 1925 h.p. electric railway.
Invested Capital: $26,555,000.

Western States Gas & Electric Company.

The American River plant of the Western States Gas & Electric Company, having a capacity of 3000 kw., was placed in operation in December, 1903, supplying power to the City of Stockton at 30,000 volt, a distance of, approximately, 60 miles. This voltage has since been increased to 60,000. In addition to this plant the company operates a 1500 kw. auxiliary steam turbine plant in Stockton, as well as hydroelectric and steam plant serving Eureka.

GROWTH OF WESTERN STATES GAS AND ELECTRIC COMPANY. STOCKTON, CAL.

Year.	No. of Electric Consumers.	Light and Power Gross Electric Revenue,	Steam Kw.-Hrs. Generated,	Miles H. T. Transmission.	Miles Overhead Distr.	Plants Installed. Hydro. No.	Kw.	Steam. No.	Kw.	Gross Revenue All Depts.
1900	.....	$ 57,241	.....	...	...	.....		.....		$128,402
1901	.....	62,521	.....	...	...	.....		.....		130,479
1902	.....	65,685	.....	...	...	.....		.....		136,408
1903	.....	67,523	.....	...	...	.....		.....		135,524
1904	.....	109,644	.....	...	...	.....		.....		183,560
1905	.....	184,292	.....	...	...	.....		.....		264,814
1906	.....	247,459	.....	...	...	.....		.....		342,843
1907	.....	287,274	.....	...	...	.....		.....		408,221
1908	.....	337,813	.....	...	...	.....		.....		482,299
1909	.....	369,364	.....	...	...	.....		.....		496,564
1910	.....	400,285	.....	...	...	.....		.....		534,320
1911	 5,490	458,237	789,300	170	189	1	3,000	1	1,500	600,058
1912	 6,477	508,273	978,700	185	318	1	3,000	1	1,500	674,947
1913	 8,091	573,584	912,200	196	321	1	3,000	1	1,500	748,202
1914	 8,719	588,052	1,268,700	201	341	1	3,000	1	1,500	778,573

This company also purchases a considerable amount of power from other companies.

Stockton, Cal.

H. M. Byllesby, President.
Samuel Kahn, Vice-Pres. and Mgr.
Transmission: Placerville to Stockton, Ca.
Distribution: 460, 230, 115 volts.

Eureka, Cal.

H. L. Jackman, Manager.
John A. Harnett, Superintendent.
Transmission: 99.5 miles at 33,000 volts.
Distribution: 104 miles at 115 volts.
Connected Load: 4020 kw. lighting, 1715 kw. industrial and agricultural power.

Power Plant, Substation and Ice Plant Holton Power Company.

Holton Power Co., El Centro, Cal.

W. F. Holt, President.
A. G. Hubbard, Vice-President.
W. G. Driver, Secretary.
M. C. Taylor, Treasurer.
C. E. Paris, General Superintendent.
R. P. Moore, Assistant Superintendent.
W. H. Brown, Electrical Engineer.

Transmission: 55 miles at 15,000 volts.
Distribution: 45 miles at 2200 and 220 volts.
Connected Load: 2262 kw. lighting, 3514 kw. industrial power.
Coachella Valley Ice & Electric Company owns and operates 139 miles 55,000 volt transmission line, Banning to El Centro. Connecting with Southern Sierras Power Company at Banning. Coachella Valley Ice & Electric Company is controlled by Holton Power Co.
Capital Stock: $1,500,000.

Nevada - California Power Company and Southern Sierra Power Company.

These two companies, serving distinct territories, and having corporate entities, are yet closely interwoven in interest and managements.

The Nevada-California Power Company serves the great Goldfield-Tonopah mining region of Southern Nevada, and with its abundant supply of energy has been one of the most potent factors in the financial success of these mining camps. The first plant was constructed in 1905, and contained two 750 kw. machines. This, with its 100 miles of transmission lines, form the nucleus of the present system of the two companies.

The rapid growth of the mining business soon called for additional transmission lines and generating capacity, and finally, in 1911, just six years later, the Southern Sierras Power Company was organized to supply the demands for power in Southern California.

The system of hydroelectric plants owned by these two companies is an exceedingly interesting example of intensive development of water power. With the surface of the main storage reservoirs more than 9700 ft. above the sea level, the water is carried by means of conduits, pipe lines, etc., successively through five different generating stations, and within a distance of 16 miles more than 5000 ft. of this head is used before it is finally utilized in the Owens River Valley for irrigation purposes.

The country to the east of the Sierra-Nevada Mountains is sparsely settled, and the market for power limited, thus making necessary much longer lines than in the more thickly settled sections. The main transmission line of this company, from Bishop to San Bernardino, is a double circuit steel tower construction 230 miles long. From this latter place 55 and 30,000 volt lines extend almost to the Mexican boundary, making the total distance of transmission 417 miles.

Silver Peak Substation Nevada-California Power Company.

GROWTH OF NEVADA-CALIFORNIA POWER COMPANY,
RIVERSIDE, CAL.

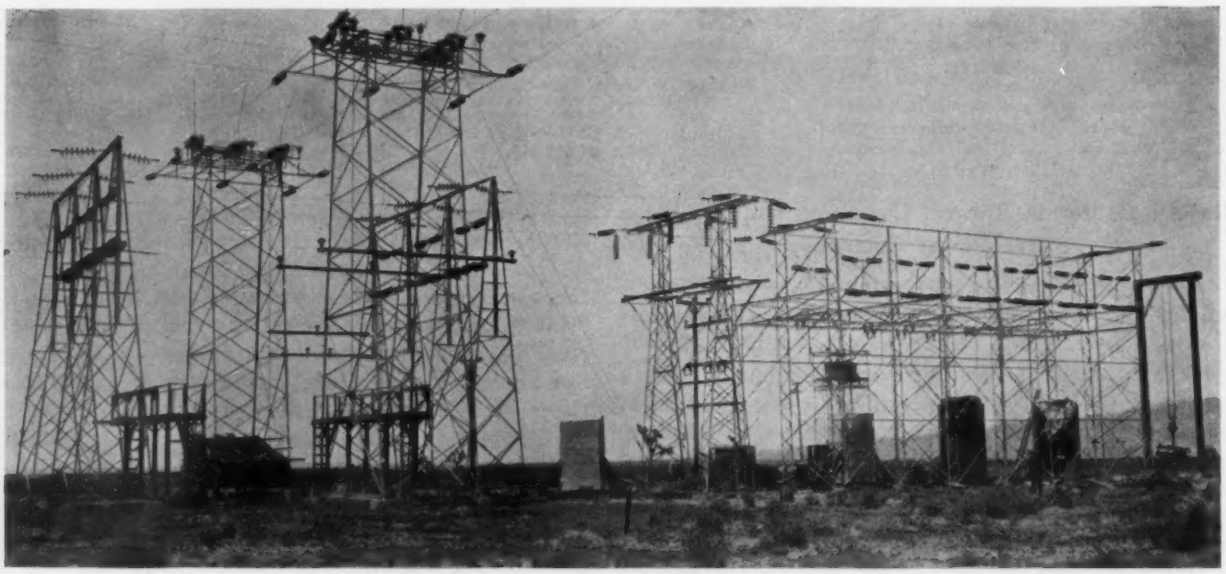
Year.	No. of Electric Consumers.	Light and Power Gross Electric Revenue.	System Load Factor.	Miles H. T. Trans-mission.	Miles Overhead Distr.	Plants Installed. Hydro. No.	Hydro. Kw.	Gross Revenue All Depts.
1908	1,305	$672,754	71%	294	120	1	6,000	$687,207
1909	1,849	710,609	77	332	131	2	7,500	717,211
1910	1,935	743,997	70	332	133	3	10,000	750,131
1911	1,960	743,900	75	332	135	3	13,500	780,391
1912	2,089	865,755	72	343	137	2	12,000	908,045
1913	2,095	990,617	76	359	141	3	18,750	998,456
1914	2,429	956,633	64	359	155	3	18,750	968,288

D. A. Chappell, President and Manager.
Rodney Curtis, Vice-President.
G. S. Wood, Vice-President.
A. B. West, Vice-President.
W. E. Porter, Secretary.
Laurence C. Phipps, Treasurer.
C. O. Poole, Electrical Engineer.
H. R. Day, Purchasing Agent.

Transmission: 359 miles at 55,000 volts.

Distribution: 155 miles at 11,000, 2200 and 440 volts.

Connected Load: 1850 h.p. residence lighting, 781 h.p. commercial lighting, 22,900 h.p. industrial power.



Outdoor Substation at Victorville, Cal.

GROWTH OF SOUTHERN SIERRAS POWER COMPANY,
RIVERSIDE, CAL.

Year.	No. of Electric Consumers.	Light and Power Gross Electric Revenue.	Steam Kw. Hrs. Generated.	System Load Factor.	Miles H.T. Trans-mission.	Miles Overhead Distr.	Plants Installed. Hydro. No.	Hydro. Kw.	Steam. No.	Steam. Kw.	Gross Revenue All Depts.
1912	972	$ 99,022	1,526,450	48%	210	250	1	1,490	1	5,000	$101,713
1913	1,565	281,417	7,585,288	52	210	289	2	3,480	1	5,000	289,220
1914	2,516	443,449	1,378,245	56	274	440	2	3,480	1	5.000	465,652

G. S. Wood, President.
D. A. Chappell, Vice-President.
A. B. West, Vice-President.
W. E. Porter, Secretary.
Laurence G. Phipps Jr., Treasurer.
D. A. Chappell, Manager.
C. O. Poole, Electrical Engineer.
H. R. Day, Purchasing Agent.

Transmission: 275 miles at 55,000 volts (built for 140,000).

Distribution: 440 miles at 33,000, 2200, 410 and 220 volts.

Connected Load: 2150 h.p. residence lighting, 1210 h.p. commercial lighting, 9487 h.p. industrial power, 8978 h.p. agricultural power.

Oro Electric Corporation, San Francisco, Cal.

Luther J. Holton, President.
R. Leo Van der Naillen, Vice-President and Manager.
W. G. Jack, Secretary.
A. A. Davis, Superintendent.
H. H. Adams, Electrical Engineer.
J. H. Williams, Purchasing Agent.

Transmission: 141.52 miles at 30,000/60,000 volts.

Distribution: 346 miles at 4400/6600 volts.

Connected Load: 534 kw. residence lighting, 435 kw. commercial lighting, 3954 kw. industrial power, 3317 kw. agricultural power.

Invested Capital: $16,936,256.

Southern California Edison Company.

This company's principal source of hydroelectric energy is its Kern River Plant No. 1, having an installed capacity of 22,000 kw.

Like most of the other companies operating in the southern part of the state, the Edison Company found that there was not available in that territory enough water to give all the hydroelectric energy that was required to meet the demands, and was forced to go further north for a possible site.

In 1906 a 22,000 kw. installation was made at Kern River, and from there power was transmitted over a three circuit steel tower line at 75,000 volts, 118 miles to the city of Los Angeles.

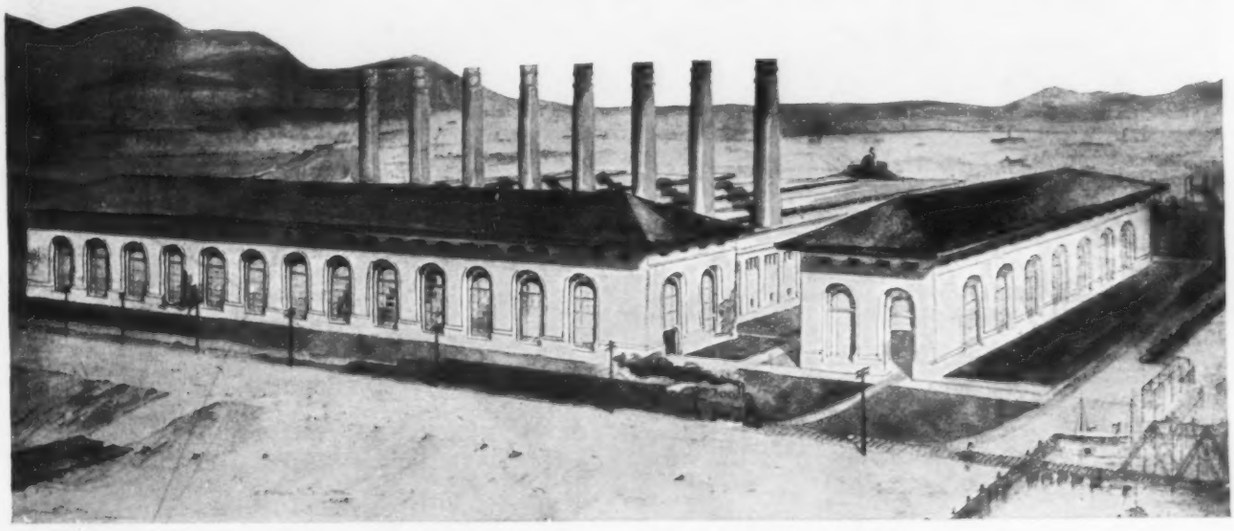
Prior to the installation of this plant the company operated a number of small hydro stations located at Santa Ana, Mill Creek and Lytle Creek. Some of these, notably the plant at Mill Creek, were among the very first three phase installations ever made. They are still being operated, their output being delivered directly into the general low voltage distributing system.

Unlike most of the other operating companies on this coast, the Southern California Edison Company has not increased its hydroelectric developments to keep pace with the increase in business, but the excess over and above what they are able to carry on their electric plants has been carried on a modern, up-to-date steam turbine plant at Long Beach, a short distance from the city of Los Angeles. This now has a capacity of 63,000 h.p. In addition to this they have a 13,000 kw. steam plant in Los Angeles that is operated as a reserve station in case of trouble on their transmission line.

GROWTH OF SOUTHERN CALIFORNIA EDISON COMPANY, LOS ANGELES, CAL.

Year.	Light and Power No. of Electric Consumers.	Gross Electric Revenue.	Kw. Hrs. Generated. Hydro.	Steam.	Sys em Load Factor.	Miles H. T. Trans- mission.	Miles Overhead Distr.	Plants Installed. Hydro. No.	Kw.	Steam. No.	Kw.	*Gross Revenue All Depts
1904	19,713	$ 886,577	19,957,913	6,129,182	30.1%	200	510	5	9,300	7	6,400	$ 970,585
1905	25,321	1,081,595	31,353,460	4.896,626	32.2	220	660	5	9,300	6	5,900	1,263,582
1906	32,764	1,049,127	45,026,250	9,243,086	35.8	220	825	5	9,300	5	11,500	1,724,335
1907	39,606	1,875,767	73,252,122	11,546,158	44.8	337	1000	6	31,600	3	11,000	2,206,381
1908	42,234	2,116,375	101,729,076	3,385,443	42.8	350	1055	6	31,600	2	10,300	2,477,062
1909	44,445	2,518,374	97,684,760	31,663,288	42.7	350	1110	6	31,600	2	10,600	2,895,407
1910	55,191	2,978,173	170,583.185	15,198,836	52.1	350	1200	6	31,600	2	10,600	3,384,933
1911	66,398	3,435,990	184,543,192	22,660,222	52.4	350	1200	6	31,600	3	22,600	3,738,165
1912	80,995	4,064,632	169,382,396	92,843,497	60.4	380	1246	6	31,600	3	37,500	4,340,501
1913	96,851	4,473,033	173,058,397	113,034,939	59.8	408	1577	6	31,600	3	57,500	4,779,280
1914	108,439	4,461,807	202,819,110	81,412,505	61.1	423	1803	6	31,600	3	57,500	4,855,141

*The above figures for Gross Revenue show the income from every source as Electric Sales and Gas Sales.



Long Beach Steam Plant, Southern California Edison Company.

John B. Miller, President.
W. A. Brackenridge, Vice-President and General Manager.
R. H. Ballard, Sec. and Asst. Gen. Mgr.
W. L. Percey, Treasurer.
B. F. Pearson, Superintendent.
J. A. Lighthipe, Electrical Engineer.
John Otto, Purchasing Agent.

Transmission: 416 miles at 60,000, 30,000, 15,000 and 10,000 volts.

Distribution: 1900 miles overhead at 110-220 volts, 22 miles underground. Frequency: 50 cycles.

Connected Load: 90,913 kw. lighting, 101,090 kw. power.

California-Oregon Power Co., San Francisco, Cal.

Jesse W. Churchill, President.
John D. McKee, Vice-President.
Alex. J. Rosborough, Secretary.
J. P. Churchill, Treasurer.
Alex. J. Rosborough, General Manager.
H. L. Walther, General Superintendent.
Sidney Sprout, Electric Engineer.
A. C. Sprout, Construction Engineer.

Transmission: 450 miles at 34,000 volts.

Distribution: 750 miles at 2300 and 110 volts.

Supplies light and power to 34 cities and towns in southern Oregon and northern California and current for operating mines, dredgers, box factories and pumping for irrigation.

Invested Capital: $10,000,000.

Sierra & San Francisco Power Company.

The main hydroelectric generating station of the Sierra & San Francisco Power Company on the Stanislaus River was put into operation by the Stanislaus Power Company in 1908. At that time the installation consisted of four 8500 kw., 4,000 volt, 3 phase generators, each direct connected to two overhung Pelton impulse water wheels, operating under a head of 1500 ft. Power was delivered over a 98 mile, 60,000 volt steel tower line to Mission San Jose, and there delivered into the general system of the Pacific Gas & Electric Company.

Subsequently, after the construction work had been suspended temporarily by the Stanislaus Company, the Sierra and San Francisco Company took over the plant, rebuilt the generators for 10,000 kw. capacity each, extended the first tower line on to San Francisco, and built a second circuit for the entire distance. They also increased their transmission voltage to 104,000, and purchased the steam plant of the United Railroads in San Francisco, with whom they had a contract to supply the greater part of their power.

In addition to this new station the company also owns the Phoenix plant, constructed in 1898, with a capacity of 1125 kw., but which has since been increased to 1875 kw. by the addition of a 750 kw. machine. It also owns and operates the Knights Ferry plant, with a capacity of 1500 kw. These small stations feed directly into a 17,000 volt distributing system supplying the mining sections of Tuolumne County.

Stanislaus Plant, Sierra & San Francisco Power Company

H. F. Jackson, Vice-Pres. & Gen. Mgr.
F. J. Blanchard, Secretary-Treasurer.
M. C. McKay, Superintendent.
J. E. Woodbridge Electrical Engineer.
L. C. Helfrich, Purchasing Agent.

Transmission: 137 miles at 104,000 volts, 250 miles at 15,000 volts.
Distribution: 225 miles at 11,000, 4000, 2300 volts.
Connected Load: 1901 kw. lighting, 65,310 power.
Invested Capital: $15,570,718.

GROWTH OF SIERRA AND SAN FRANCISCO POWER COMPANY, SAN FRANCISCO, CAL.

Year.	Light and Power No. of Electric Consumers.	Gross Electric Revenue.	Kw. Hrs. Generated.	System Load Factor.	Miles H.T. Transmission.	Miles Overhead Distr.	Plants Installed. Hydro. No.	Hydro. Kw.	Steam. No.	Steam. Kw.	Gross Revenue All Depts.
1913	3,117	$1,050,391	27,714,900	33.1%	480	205	3	43,375	1	18,000	$1,109,493
1914	3,717	1,082,065	9,984,700	31.2	480	249	3	43,375	1	18,000	1,139,292

Coast Valleys Gas & Electric Co., San Francisco, Cal.

Chas. N. Black, President.
H. F. Jackson, Vice-Pres. & Gen. Mgr.
F. J. Blanchard, Secretary-Treasurer.
M. C. McKay, Superintendent Operation.
J. E. Woodbridge, Electrical Engineer.
L. C. Helfrich, Purchasing Agent..

Transmission: 66 miles at 33,000 and 22,000 volts.
Distribution: 225 miles at 4000 and 2300 volts.
Connected Load: 2840 kw. lighting, 3770 kw. power.
Invested Capital: $1,769,665.

Snow Mountain Water & Power Company.

The Snow Mountain Water & Power Company first put into operation in April, 1908, its 6000 kw. plant, located in Potter Valley, and by September of that same year had completed the construction of a 60 kv. transmission line to Santa Rosa, a distance of 76 miles, and began delivering the greater part of this output at this voltage to the Pacific Gas & Electric Company. They do not do a general distribution business, but wholesale their entire output to other distributing companies.

GROWTH OF SNOW MOUNTAIN WATER & POWER CO., UKIAH, CAL.

	Light and Power			Miles H. T. Transmission.	Plants Installed Hydro.	
Year.	No. of Electric Consumers.	Gross Electric Revenue.	System Load Factor.		No.	Kw.
1908	4	$ 10,754	40%	76	1	4,000
1909	6	37,343	15	93	1	6,000
1910	6	139,814	46	105	1	6,000
1911	7	126,995	55	106	1	6,000
1912	7	127,980	65	106	1	6,000
1913	7	124,576	59	106	1	6,000
1914	6	127,963	58	106	1	6,000

Snow Mountain Power House.

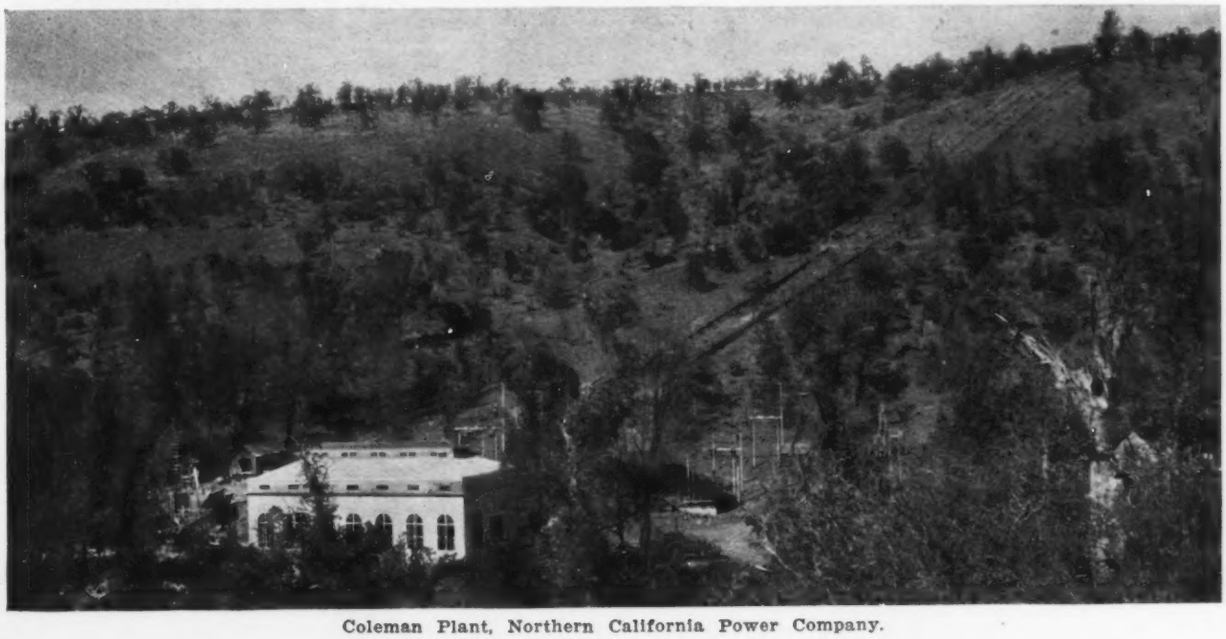
C. N. Felton Jr., President.
F. D. Madison, Vice-President.
P. H. McGrath, Secretary.
C. N. Felton Jr., Treasurer.
W. S. Graham, Manager.

Transmission: 113 miles at 55,000 volts.
Distribution: This company wholesales power to distributing companies and has no distributing system of its own. Its present power house capacity is 6000 kw.
Invested Capital: $5,000,000.

Northern California Power Co., Cons., San Francisco, Cal.

W. F. Detert, President.
A. S. Carman, Vice-President.
F. Reis Jr., Vice-President.
Edward Whaley, Sec. and Pur. Agent.
E. V. D. Johnson, Manager.
R. E. Frickey, Electrical Engineer.

Transmission: 562 miles at 60,000 and 20,000 volts.
Distribution: 533 miles at 6600, 2200, 220, 110 volts.
Connected Load: 3895 kw. residence lighting, 1622 kw. commercial lighting, 8932 kw. industrial power, 5293 kw. agricultural power 13,522 kw. mining power.
Invested Capital: $16,998,000.



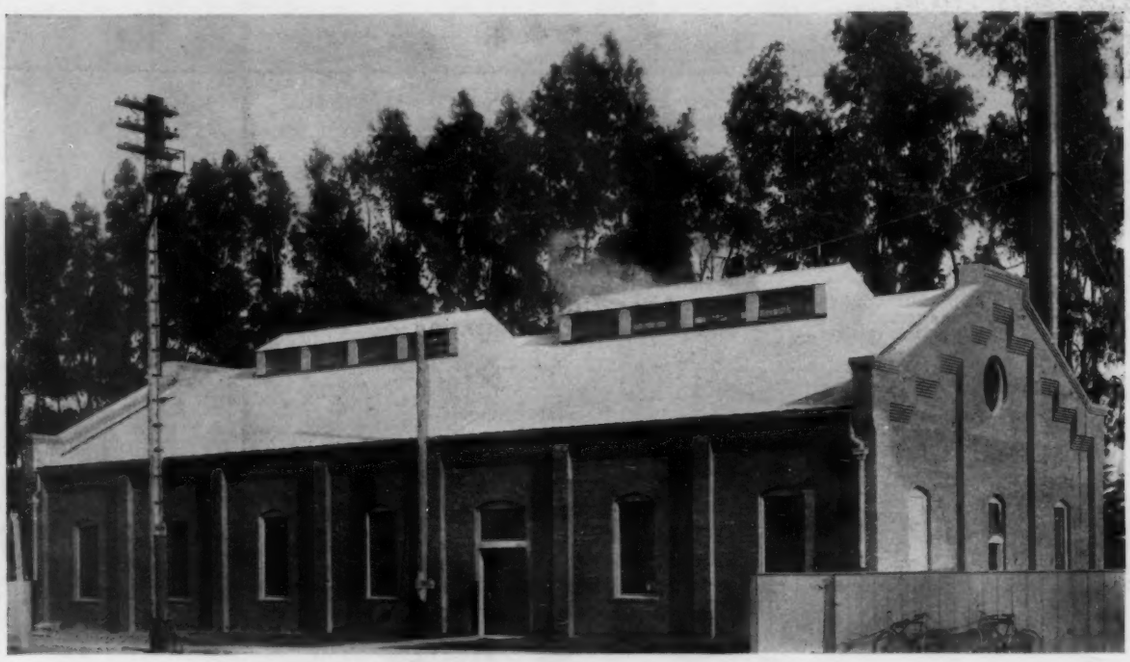
Coleman Plant, Northern California Power Company.

Substation and Power House, Coast Counties Gas & Electric Company.

Coast Counties Gas & Electric Co., San Francisco, Cal.

S. Waldo Coleman, Pres. & Gen. Mgr.
R. M. Hotaling, Vice-President.
L. W. Pryor, Secretary-Treasurer.

Transmission: 86 miles at 22,000 volts.
Distribution: 675 miles at 2300 volts two-phase and 4000 volts three-phase.



Substation of Ventura County Power Company.

Ventura County Power Co., Oxnard, Cal.,

G. C. Ward, President.
F. W. Hunter, Vice-Pres. & Gen. Mgr.
O. V. Showers, Secretary.
A. N. Kemp, Treasurer.
H. A. Barre, Electrical Engineer.
W. T. Gracey, Purchasing Agent.

Transmission: 56½ miles at 33,000 volts.
Distribution 184 miles at 2300 volts, 50 cycle.
Connected Load: 3011 lighting consumers, 1714 h.p. industrial power, 1894 h.p. agricultural power.
Invested Capital: $1,328,011.

Washoe Plant and Transmission Line Sierra Pacific Company.

Sierra Pacific Co.—The Truckee River General Electric Co., Reno, Nev.

Alfred von der Ropp, President.
Wendell P. Hammon, Vice-President.
Chas. F. Wallace, Vice-President.
B. Alcott Pratt, Vice-President.
Alvah K. Todd, Secretary.
Chas. Hayden, Treasurer.
Stone & Webster Management Association, General Managers.
Geo. A. Campbell, Mgr. and Pur. Agent.
E. D. Brown, Electrical Superintendent.
Philip M. Wentworth, Elec. Engineer.

Transmission: 272.5 miles at 60,000 and 23,000 volts.
Distribution: 170 miles at 4000 and 2300 volts.
Connected Load: 4777 kw. lighting, 9532 kw. power, 500 kw. electric railway.

Fossil Creek Plant, Arizona Power Company.

The Arizona Power Co., Prescott, Ariz.

F. S. Viele, President.
R. S. Masson, Vice-President.
A. P. Talliaferro, Secretary and Treas.
M. V. Watson, Manager and Supt.
R. S. Masson, Electrical Engineer.
O. Jett, Purchasing Agent.

Transmission: 120 miles at 45,000 volts.
Distribution: 20 miles at 11,000 and 2300 volts.
Connected Load: 5850 h.p.
Capital Stock: $6,000,000.

Nevada Valleys Power Co., Oakland, Cal.

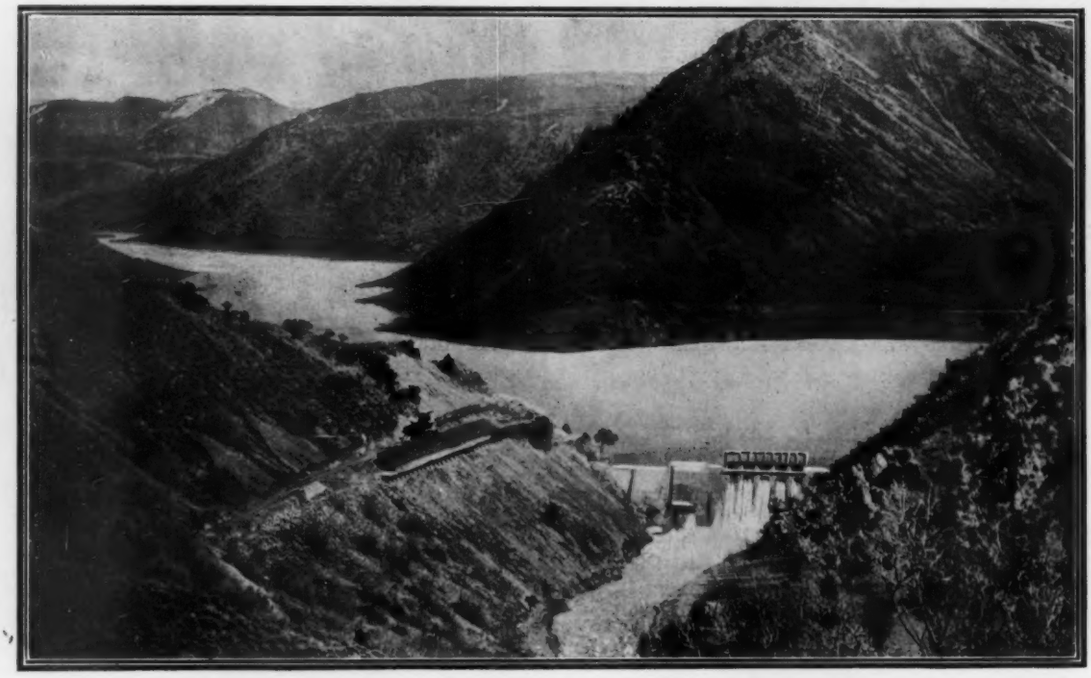
E. F. Adams, President.
J. Q. Brown, Manager.

Transmission: 83.3 miles at 66,000 volts.
Distribution: 6600 volts.
Transmission power from U. S. Reclamation Service plant at Lahonton to Hazen and Lovelock.

Utah Power & Light Co., Salt Lake City.

G. W. Whitley, President.
C. E. Groesbeck, Vice-President.
Jos. S. Wells, Secretary-Treasurer.
H. L. Beach, Manager.

Transmission: 135 miles at 130,000 volts. Large mileage at 44,000-22,000-16,000.
Distribution: ,000-6600-2300-440-220-110 volts.
Installed Capacity: 150,000 kw.



Oneida Dam and Reservoir of Utah Power & Light Company.

The Western Colorado Power Co., Montrose, Colo.

Bulkeley Wells, President.
G. E. Claflin, Vice-President.
E. P. Summerson, Secretary-Treasurer.
J. A. Clay, General Manager.
W. A. Fallon, Electrical Engineer.
H. G. Baker, Purchasing Agent.

Transmission: 76 miles at 50,000 volts.
Distribution: 225 miles at 17,000, 10,000 and 2300 volts.
Connected Load: 2482 kw. residence lighting, 798 commercial lighting, 9227 kw. industrial power (mining), 145 kw. electric railway.

Ames Plant of Western Colorado Power Company.

The Colorado Power Co., Denver, Colo.

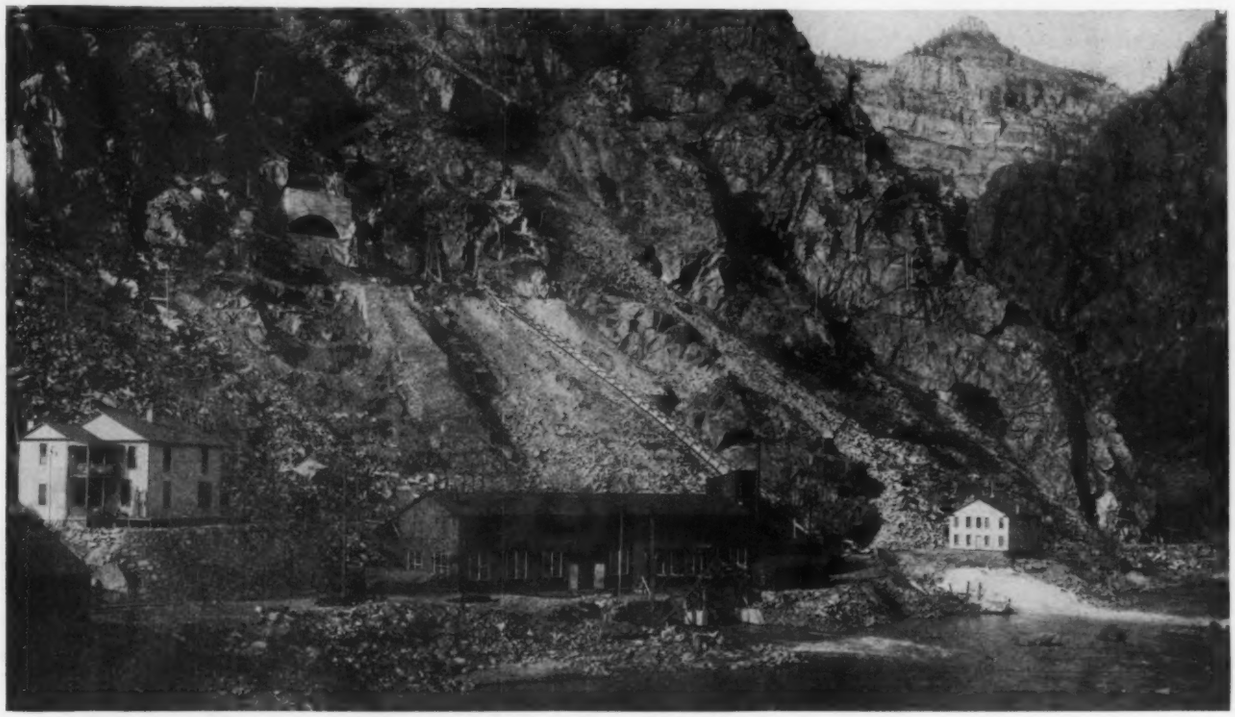
G. H. Walbridge, President.
G. Z. Mitchell, Vice-President.
I. W. Day, Secretary.
D. E. Houston, Treasurer.
L. P. Hammond, Manager.
L. H. Shute, Superintendent.
Porter Eveland, Electrical Engineer.
Norman Read. Asst. General Manager and Purchasing Agent.

Transmission: 185 miles at 100,000 volts.

Distribution: 31.2 and 104 miles at 6600 and 13,000 volts respectively.

Connected Load: 30,863 h.p. commercial lighting and power, 2010 h.p. electric railway.

Invested Capital: $15,445,506.



Shoshone Plant, The Colorado Power Co.

National Securities Corporation, Boise, Idaho.

This is subsidiary of the Electric Bond & Share Company, organized to acquire several Idaho companies now in the hands of receivers, including:

Idaho-Oregon Light & Power Co.; Receiver, W. J. Ferris, Boise;

Idaho Railway, Light & Power Co., Receiver, O. G. F. Markhus, Boise;

Idaho Power & Light Co.; President, L. L. Nunn, Boise; and possibly the Kuhn companies:

Great Shoshone & Twin Falls Water Power Co., Twin Falls;

Southern Idaho Water Power Co., Pocatello.

Desert Power & Water Co., Kingman, Ariz.

F. A. Wilde, President.
R. W. Wilde, Vice-President.
W. A. Richardson, Secretary.
F. A. Wilde Jr., Treas and Manager.
Joseph Steel, Superintendent.
W. S. Henning, Electrical Engineer.

Transmission: 50 miles at 45,000 volts.

Distribution: 10 miles at 2300, 220, 110.

Capacity: 6000 kw. steam plant supplying current to San Francisco district, gold mines, and towns of Kingman, Gold Roads, Oatman and Oil Trail.

Southern Utah Power Co.—The Beaver River Power Co., Provo, Utah.

Beaver River Power Company:
F. C. Noon, President.
P. N. Nunn, Vice-President.
H. R. Waldo, Secretary.
W. L. Biersach, Treasurer.
A. L. Woodhouse, Manager.
H. E. Diehl, Superintendent.
Southern Utah Power Company:
A. L. Woodhouse, Pres. & Gen. Mgr.
C. E. Erickson, Vice-President.
H. R. Waldo, Secretary.
W. L. Biersach, Treasurer.
F. J. Wight, Superintendent.

Transmission: 157 miles at 44,000 volts.

Distribution: 75 miles at 5000 volts.

Connected Load: 500 kw. residence lighting, 20 kw. commercial lighting, 1000 kw. industrial power, 90 kw. agricultural power.

The Beaver River Company operates in Beaver County only. Southern Utah Power Company operates in Piute, Servier and San Pete Counties. Power for both companies developed upon the Beaver River.

The Arkansas Valley Railway, Light & Power Co., Pueblo, Colo.

Geo. H. Harries, President.
Otto E. Osthoff, Vice-President.
Herbert List, Secretary.
R. J. Graf, Treasurer.
W. F. Raber, Manager.
E. F. Stone, Superintendent.
C. A. Orr, Electrical Engineer.
S. G. Cunningham, Purchasing Agent.

Transmission: 211 miles at 24, 000, 23,000 and 13,000 volts.

Distribution: 250 miles at 6600/2300 volts.

Connected Load: 14,046 kw. lighting, 14,292 kw. industrial and agricultural power, 720 kw. electric railway.

Conclusion.

With all of the hydroelectric installations that have been made during the past few years, there is yet a field for still greater development, and with the possible exception of a few instances of over-development in the Pacific Northwest, the power companies of the Pacific Coast have not built ahead of the demand.

Financing new projects of this kind, particularly where any part of the plant is on public domain, is something that has been given a great deal of consideration. On the Pacific Coast there are vast areas of unoccupied land under government ownership. A considerable part of this land has been withdrawn from entry and set aside as forest reserve. The administrative jurisdiction over national forests is by law vested with the Secretary of Agriculture, who is authorized to regulate their occupancy and use, but the Secretary of the Interior has jurisdiction over all matters relating to patenting and granting of easements over these lands. By the practice and regulations of the Department of the Interior, applications for rights of way in the national forests are referred to the Secretary of Agriculture by the Secretary of the Interior for recommendation before final action is taken. The result of this dual jurisdiction has been the adoption of regulations governing the construction and operation of storage reservoirs, canals, ditches, pipe line and power houses used in connection with the generation of hydroelectric power that will not permit the granting of an easement in perpetuity, or for any specified length of time. Power companies are, therefore, left in the position, so far as forest reserve property is concerned, of not being able to acquire title in fee to the property at any price, and by the regulations of the Department of the Interior they cannot secure an easement or right of way across the property, except such as is terminable at the pleasure of the Secretary of the Interior. This, with other equally onerous requirements entirely inconsistent with the value or rights granted, has made it very hard to interest capital in developments any part of which are on the forest reserve. There is at least one company on the coast today using a large amount of steam generated power, for the reason that they have been unable to finance the further development of their water power properties, a part of which would fall within the forest reserve. Another company having under way the construction of a plant, representing an ultimate capacity of 50,000 kw., found that 1320 ft. of the canal right of way was across one corner of the forest reserve. The property was not valuable timber land, as is evidenced by the fact that several thousand acres all around it was purchased for $3.00 per acre, and even this price was considered more than it was worth. Nevertheless the inflexible regulations of the Department of the Interior had to be complied with. Rather than to sign the required permit and thereby to that extent cloud the title to the property, it was finally forced to construct an inverted syphon around the property at an extra expense of approximately $70,000.

From the foregoing data it will be seen that the combined hydroelectric developments in California, Oregon and Washington amount to approximately 837,000 kw. To find a market for this amount of power within a period of only 25 years has been no small undertaking, and to dispose of it the sales organizations of the various operating companies have been forced to conduct constant campaigns of education in their endeavors to teach the people to do things electrically. The results of these campaigns speak for themselves.

The Pacific Coast does not have as many manufacturing industries as do some of the eastern states, nor is there any other particular line of industry that uses any appreciable proportion of the entire output of the different plants; in other words, there is a much greater diversity of load in the West than will be found in the average large industrial centers of the East, where manufacturing is a more important factor.

Like every other new industry, the growth of the electrical business on the Pacific Coast was slow at first. This was particularly true in the small towns and rural districts, where, before the advent of hydro-generated power, electric service had not been available. In order to secure even the lighting business it was necessary to offer special inducements in the form of flat rates. For years many communities enjoyed such rates for both light and power. The power companies endeavored to justify a rate of this kind on the theory that the size of a generating station was fixed by the peak load it had to carry, and as the motive power operating the plant was water, which, if it were not used through the plant, would go to waste, it did not cost any more to give service throughout the twenty-four hours than it did during the few hours over the lighting peak. Under certain conditions such a theory might hold, but the experience of the different companies has been that getting rid of this flat rate business is a problem that has given them much greater concern than was that of securing it.

Inverted Siphon Circumventing Forest Reserve

Many other inducements were offered to secure business. In most of the California valleys and in the fruit growing sections along the foothills an abundance of water for irrigation purposes can be had by pumping from wells. Before electric power was available this work was done by gasoline engines, and the users having their plants installed, were slow to make a change. In many instances the power companies replaced gasoline engines with electric motors at their own expense, with the understanding that if the consumer was not better satisfied with the electrically operated plant than he had been with the gas driven, the motor would be taken out and the plant restored to its original condition without expense to the consumer. If, on the other hand, the motor installation proved satisfactory, the consumer would keep it, and pay for it on easy installments, or the power company would take the gas engine off his hands as part or full payment for the motor. It is needless to say that the motors remained in service, and although the first cost of getting the business may have been high, irrigation pumping has become so well established and the returns so satisfactory that the expense incurred in securing the business has been amply justified.

A similar condition obtained in the case of pumping for reclamation purposes, but now electric power has the entire field almost to itself.

Gold dredging in the beds of streams leading from the Sierra Nevada Mountains is an industry that was made possible and grew up along with the electrical business. After many unsuccessful attempts to operate their boats by steam, the dredger people did not hesitate to adopt electric power as soon as it was available. The power requirements of these boats has during the past few years increased from 100 to 200 h.p. on those first built, to 1000 or more horsepower on the larger, more modern dredgers now being built.

The possibility of operating oil wells and derricks with electric motors in place of steam engines opened up another enormous opportunity for the disposal of electrical energy, and although it is only during the past few years that the oil people have come to recognize the advantages of electric power, a very large proportion of the wells in the California oil fields are now being operated electrically.

These, with the many other classes of business that have been obtained only by a liberal policy of line extensions, have enabled the power companies of this coast to build up load factors fully as high, and in many instances higher, than obtain on some of the larger and older companies in the East. The following table shows the load factors of a number of the larger operating companies:

LOAD FACTORS.
Table No. 3.

	Per Cent.
Niagara Falls Power Company	81.0
Commonwealth Edison Company, Chicago	40.0
New York Edison Company	34.7
Philadelphia Electric Company	34.4
Boston Edison Company	32.5
Pacific Gas & Electric Company, California	60.6
Portland Railway, Light & Power Company, Oregon	47.6
Puget Sound Traction, Light & Power Co., Washington	50.0
Washington Water Power Company, Washington	65.3
Great Western Power Company, California	65.0
Pacific Light & Power Company, California	48.0
Sierra & San Francisco Power Company, California	31.2
Nevada-California Power Company, California & Nevada	64.0
Southern California Edison Company, California	61.1
San Joaquin Light & Power Corporation, California	64.0

Electric power is being supplied to no less than 115 different types of Western industries in the fields of agriculture, mining, manufacturing and transportation.

The costs attendant upon the operation of hydro-electric plants are practically fixed, and in a lesser degree this is also true of steam plants. It is, therefore, extremely desirable that such plants should be worked as nearly as possible to their full capacity.

It is characteristic of Western power systems that they cover a more extended area and have a greater diversity of load than Eastern systems. Industrial power, both periodic and twenty-four hour, usually brings the load factor well up, particularly in the summer, when the eight-hour industrial load comes off about the time the lighting and railway peaks come on.

Considerable irrigation load is carried by most Western companies, which operate in some cases twenty-four hours a day, but to a great extent this irrigation load comes on after the sun is down and the pumping is done during the night.

The Pacific Coast has not heretofore been classed among the zones in which manufacturing is a leading industry, but with abundant oil for fuel for manufacturing power and motive power on the one side, and with nine million horsepower in water power maximum developments, and the widening of markets, both at home and in the Orient, our West can face an industrial future with confidence.

ELECTRICAL PROSPERITY WEEK.

Approval of the completed general plans for "Electrical Prosperity Week" was voted at the meeting of the Advisory Committee held in the offices of the Society for Electrical Development, Wednesday, May 19th. The committee members present renewed pledges of support and commented highly on the manner in which the campaign has been handled to date. Within two weeks the Society will publish the proposed plans in a twenty page booklet. Those present at the meeting were: F. H. Gale, advertising manager General Electric Company, Schenectady; P. L. Thomson, advertising manager Western Electric Company, New York; F. Nelson Carle, advertising manager General Vehicle Company, Long Island City; M. S. Seelman, assistant general sales agent Edison Electric Illg. Company, Brooklyn; J. H. Donnelly, editor and publisher "Electric Sign Journal," New York City; T. J. McManis, manager publicity department Edison Lamp Works, Harrison, N. J.; Howard K. Mohr, advertising manager Philadelphia Electric Company, Philadelphia; A. E. Hurst, "Dry Goods Economist," New York City, together with the staff of the Society for Electrical Development, Inc.

Prosperity will be the main theme of the campaign. As bankers, businessmen and citizens of the only great nation on earth not plunged into the horrors of war, these men understand in the fullest measuse the injury to business and the soundness of America's institutions, occasioned by the calamity howler. They plan to spend large sums of money and to aim the power of their companies in a combined undertaking to rout the bogy of hard times and convince people that Prosperity is real and lasting.

TOPOGRAPHIC STADIA SURVEYING.

BY WILLIAM M. STRONG.

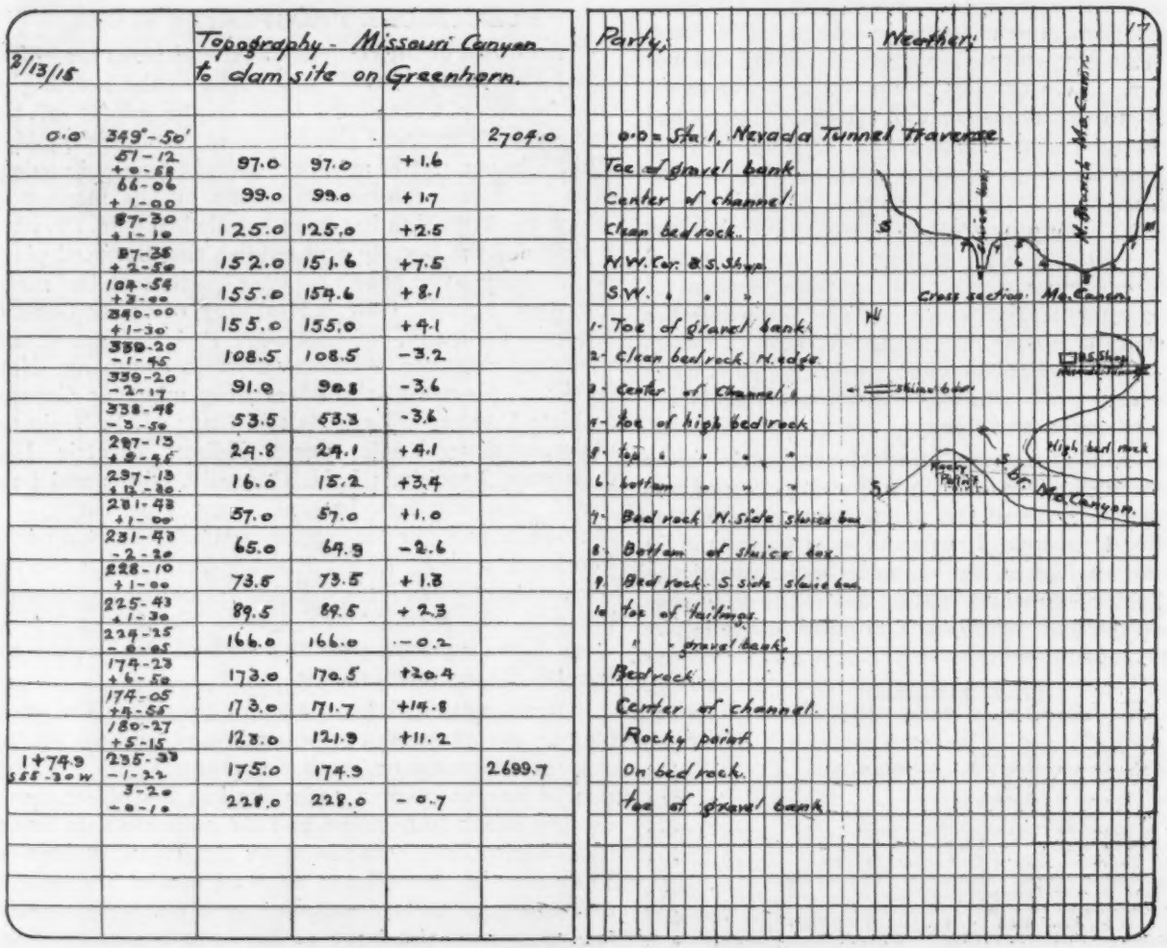
(Suggestion for making an accurate topographic survey by means of stadia readings are presented as the results of the writer's experience. Detailed directions for the note-book and rod form are included. Mr. Strong is consulting engineer at Denver, Colo.—The Editor.)

The value of stadia topographic field notes depends upon the accuracy of the instrument work and the correctness of the recorded observations. When several topog parties are working on the same survey it is important that uniformity be maintained in both the method of doing the field work and the form in which the field notes are recorded. It is also important that the field notes be kept in such manner that correct interpretation by the draftsman is assured whether the notes are plotted immediately in the field or months afterwards in the drafting office.

While holding the position of resident engineer of a large irrigation project in Colorado a few years ago it became necessary to systematize the method of taking topography then in use and the following instructions are the result of the writer's experience in connection with the surveys referred to and with later surveys in other localities.

The accompanying specimen pages of field notes show the form adopted as standard. The usual transit field book is ruled with six spaces on the left hand page. It is therefore necessary to record the observed azimuth and vertical angle in the same column as shown. As the vertical angle is always preceded by the plus or minus sign there is no confusion when the notes are plotted. In the field the notes are entered in the first three columns. Side notes and sketches should be made carefully and as complete as possible. Elevations of transit stations are determined accurately by a leveling party. Check levels should be run and permanent benches established at least one per mile and should be located near some convenient transit station and the tie to same recorded. Stadia notes of a day's work should be computed each evening and the station elevations entered in the transit book from the level notes before extending the elevations of all remaining observation points.

The form of stadia rod recommended is shown by accompanying illustration and can be manufactured in the camp. The rod is read from the top downwards. Red discs mark the 5 and 10 ft. intervals and are easily distinguished at long distances. The HI of the instrument is assumed to remain constant and is indicated by a red cross at about 4.8 ft. from the ground. The two bottom spaces on the rod are left unmarked as a check against placing or reading the rod wrong end up.



		Topography - Missouri Canyon to dam site on Greenhorn.			
2/13/15					
0.0	349°-50'				2704.0
	57-12 +0-58	97.0	97.0	+1.6	
	66-06 +1-00	99.0	99.0	+1.7	
	87-30 +1-10	125.0	125.0	+2.5	
	87-36 +2-50	152.0	151.6	+7.5	
	104-54 +3-00	155.0	154.6	+8.1	
	340-00 +1-30	155.0	155.0	+4.1	
	339-20 -1-45	108.5	108.5	-3.2	
	339-20 -2-17	91.0	90.8	-3.6	
	338-48 -3-50	53.5	53.3	-3.6	
	287-13 +2-45	24.8	24.1	+4.1	
	237-13 +12-30	16.0	15.2	+3.4	
	281-43 +1-00	57.0	57.0	+1.0	
	231-43 -2-30	65.0	64.9	-2.6	
	228-10 +1-00	73.5	73.5	+1.8	
	225-43 +1-30	89.5	89.5	+2.3	
	224-25 -0-05	166.0	166.0	-0.2	
	174-23 +6-50	173.0	170.5	+20.4	
	174-05 +4-55	173.0	171.7	+14.8	
	180-27 +5-15	123.0	121.9	+11.2	
1+74.9 S55-30W	235-33 -1-32	175.0	174.9		2699.7
	3-20 -0-10	228.0	228.0	-0.7	

Specimen Pages of Field Notes and Form of Stadia Rod.

in one piece. It is 16 ft. long and .4 ft. wide by 7/8 of an in. thick. The boards should be given two coats of white paint, after which the foot marks .1 of a foot wide should be painted in black to which varnish has been added. The middle of the black strip indicates the point of measurement. After the foot marks are painted the tenths are inserted. Lastly the 5 and 10 ft. discs and HI cross are painted red.

Traverse distances between stations should be read with a standard target rod. The transit should be kept in as accurate adjustment as possible and the stadia wires frequently checked on a measured base line of 200 to 400 ft. in length. It has been the writer's experience that with careful work, the instrument being in good adjustment, a random closed traverse 5 miles in length can be run by stadia with an error of closure not greater than 20 ft. and this over rough country.

After the notes are handed to the draftsman all computation should be checked. Transit stations should be plotted by latitude and departure careful allowance being made for meridian corrections. Observations for meridian should be made at least once every six miles of departure and full notes of such observations recorded so that the draftsman can check the computations.

After the stadia stations are plotted the side notes can be filled in by means of a 10 in. or 12 in. protractor and scale.

In this connection the value of the side notes and sketches will be appreciated as upon them depends in a large measure the accuracy and detail of the contours and topographic features, as interpreted by the draftsman.

The magnetic course recorded in the first column is used only as an approximate check on the correct record for azimuth and may vary from the correct azimuth several minutes to a degree or more on account of local attraction at different points of observation.

A UNIQUE METHOD OF STARTING SQUIRREL CAGE INDUCTION MOTORS.

The following method has been employed successfully in the Emerson Hardwood Company's saw mill in Portland, Oregon, and at quite a material saving in first cost of the installation. The motors are 3 phase, 440 volt induction motors, and no autostarters are used, but a 300 volt bus is provided for starting. Double throw Westinghouse oil switches are used for this duty. Every motor being protected with both "starting" and "running" fuse protection. The size of the starting bus is comparatively small, as only one motor can be started at a time, as all the starting equipment is centrally located at the main distributing cabinet. The main buses are 3-600,000 cir mil copper and the starting buses are 3-0000.

The following motors are installed:

1-	5	hp.	440	v.,	3	phase,	60 cycle, Ind. Motor—Filing room
1-	40	"	"	"	"	"	" Veneer mill
1-	75	"	"	"	"	"	" Line shaft
2-	40	"	"	"	"	"	" Planing mills
1-	2	"	"	"	"	"	" Air camp
1-	20	"	"	"	"	"	" Rip saw
1-	50	"	"	"	"	"	" Line shaft in Saw mill
1-	40	"	"	"	"	"	" Gang saw

Total, 312 h.p.

All of the raising is in rigid iron conduit.

THE ELECTRIC COOKING PROBLEM.

A Suggested Solution.

BY R. E. FRICKEY.

(Description and details of operation of a novel form of electric fireless cooker are given by the author, who is electrical engineer for the Northern California Power Company at Redding, Cal.—The Editor.)

"What do member companies consider the greatest obstacle at the present time in the path of electricity, as applied to cooking?" This question was repeated in the Bulletins of the National Electric Light Association from June to December, 1914. A summary of the many replies from interested and competent men seems to prove that the use of electricity for cooking has been held back by the following causes:

Electro Thermal Storage Cooker Under Test

1. High cost of cooking apparatus.
2. High cost of operation, due to:

Inefficient application of heat, hence high kw.-hr. consumption.

Heavy demand of apparatus, hence large element necessary in rate for interest, depreciation and maintenance of special transformers, services, meters and mains.

High peak load, overlapping normal station peak, hence large element in rate for the necessary station apparatus.

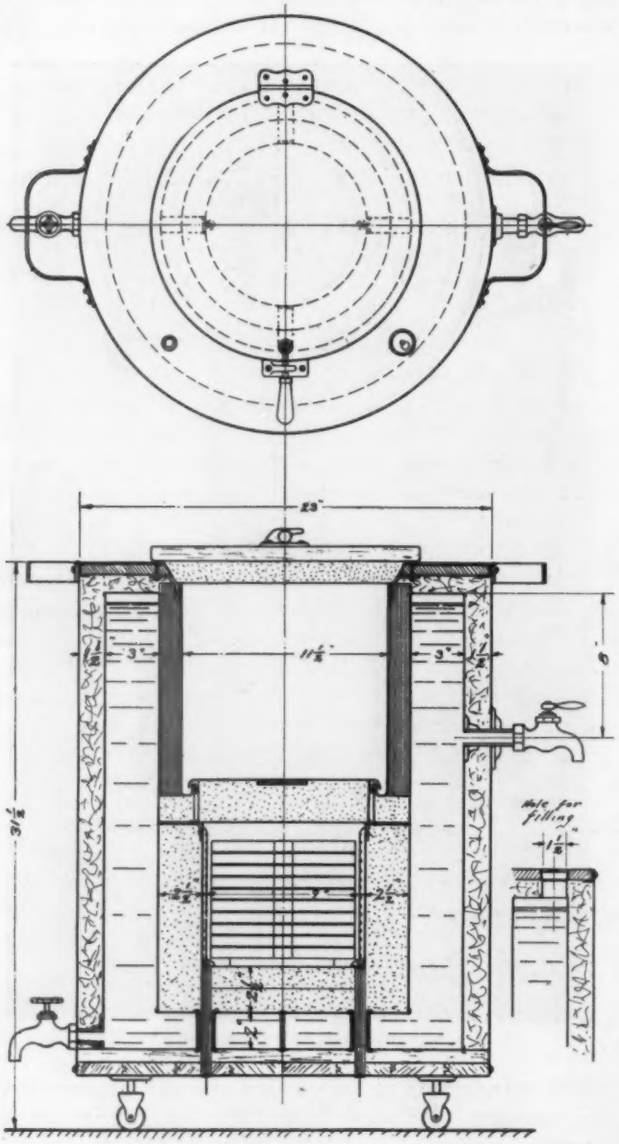
3. High cost of hot water supply.

The writer has long realized the existence of these obstacles, and believes that he has found, at least for

The rod is made of straight grained pine or spruce

the local conditions which he has to meet, a solution of the problem in the development of the thermal storage cooker described and discussed below.

One type of the cooker is illustrated herewith. It is seen to consist of a heating chamber wherein a plurality of cast iron radiators are maintained at practically constant temperature by the surrounding heating element which is in constant service, except as noted later. Above the heating chamber, and separated therefrom by a removable cover, is a cooking chamber, which in turn is made accessible by a hinged cover.



Plan and Section of Thermal Storage Cooker.

Both chambers are surrounded by heat insulation, and a water jacket surrounds this. The outside of the water jacket is suitably insulated and protected by a metal cover. A means is provided for filling and for drawing water from the reservoir. Other types have been developed for utilizing water under pressure in the water jacket.

The same principles have also been carried out for multiple cooking chambers, both with and without multiple heating chambers. Other modifications to meet special conditions are in the course of development.

When required, an immersion type water heater, (not illustrated) is provided within the reservoir. This may be arranged for continuous use, may be controlled by hand, as wanted, or may be automatically controlled by a thermostat.

A small portion of the total energy output is required to heat the radiators, hence most of the heat flows outwardly to the water jacket through the insulation surrounding the heating chamber. This insulation is so designed that the temperature drop with the normal heat flow, plus the fairly constant water temperature, is equal to the temperature desired in the heating chamber.

Again, the cooking chamber is separated from the water reservoir by suitable insulation. This insulation, as well as the metal lining of the chamber, is maintained at a high temperature, both by the surrounding hot water, and by the heat leaking through the cover of the heating chamber.

The water jacket is constructed of tinned copper. The cooking chamber is lined with seamless drawn aluminum, and the hinged cover is made from the same material, with the steam-tight joint and steam valve common to fireless cookers.

A convenient single-phase a.c. electromagnet is provided for lifting the cover of the heating chamber and the radiators, one at a time. Two convenient brackets are provided for supporting the cover and the radiators when transferring these.

Broiling, frying and similar operations cannot be performed in the cooker. For these operations a special radiant grill, having a demand of 700 watts, (say, one horsepower) has been found adequate. This grill is 8½ in. in diameter and is designed to broil or fry, as required. The demand of this grill fixes the maximum demand of the entire apparatus for general cooking. This is so because the heating element within the cooker may be disconnected for short intervals without appreciably changing the temperature of the radiators. In practice, a double throw switch is used to disconnect the cooker while the grill, or other special device, as a percolator, is being used.

For many cooking operations, the cooking chamber may be used without radiators and without previously heating the food. In this manner cereals, rice, beans, and similar food, are thoroughly cooked over night. The energy for these operations comes through the cover over the heating chamber. For most cooking operations a single hot radiator is transferred to the bottom of the cooking chamber. For roasting and for baking operations, a radiator is used both below and above the food. When baking two or more pies or cakes at one time, one radiator more than the number of articles is used.

A convenient attachment is furnished with the cooker as an extra. This consists of a radiant electric grid covered by a reflector and air baffle. A tube normal to the reflector at its center point carries the feed wires. To use the attachment, the cover of the cooker is raised and the tube is inserted through the steam valve opening in the cover. The cover is then closed and by means of the tube and suitable thumb

screw the grid is adjusted to the proper height above the food to be cooked. While this device is really not needed for baking or roasting, many remarkable effects may be obtained with it's use. It is adjustable, both as to energy input, and as to position, relative to the food. The maximum demand is 400 watts. It may be used with heating element of the cooker on or off, depending upon the manner of wiring.

While many of the cooking operations are similar to those employed in the use of ordinary fireless cookers, the results obtained in the cooker described are far superior, and the operations are more simple and convenient. The radiators are always ready for instant use. The wall of the cooking chamber is maintained, substantially, at a constant temperature, (approx. 750 C.) Therefore, food being cooked is not robbed of the energy ordinarily required to heat the cover, lining and insulation surrounding the cooking chamber. Also, the temperature of this chamber cannot fall below the minimum referred to, no matter how long the cooking operation continues, because of the equalizing effect of the water jacket and of the heating chamber cover. Bacteria cannot live at the temperature which is maintained at all times, hence the lining of the cooking chamber can never become foul, as is common with many types.

An input of 200 watts has been found sufficient to heat ten radiators, daily, and to furnish five gallons of water, daily, at a temperature sufficiently high for all domestic purposes. This number of radiators has been found to be adequate for cooking for a family of from five to ten people. Additional hot water may be obtained as desired by the use of the immersion heater within the water jacket, but it should be remembered that the energy used for this purpose is utilized at nearly 100 per cent efficiency, since all losses are already accounted for in the 200 watts normal input. If a constant daily demand exists for more water than is normally provided, this should be obtained by a constant input, providing additional unity load factor load. At 100 per cent efficiency, approximately, 10 gallons of water may be heated in 24 hours from 20 degrees C. to 75 degrees C. with an input of 100 watts. Under this condition, it is possible, economically, to meet all demands for hot water for domestic uses.

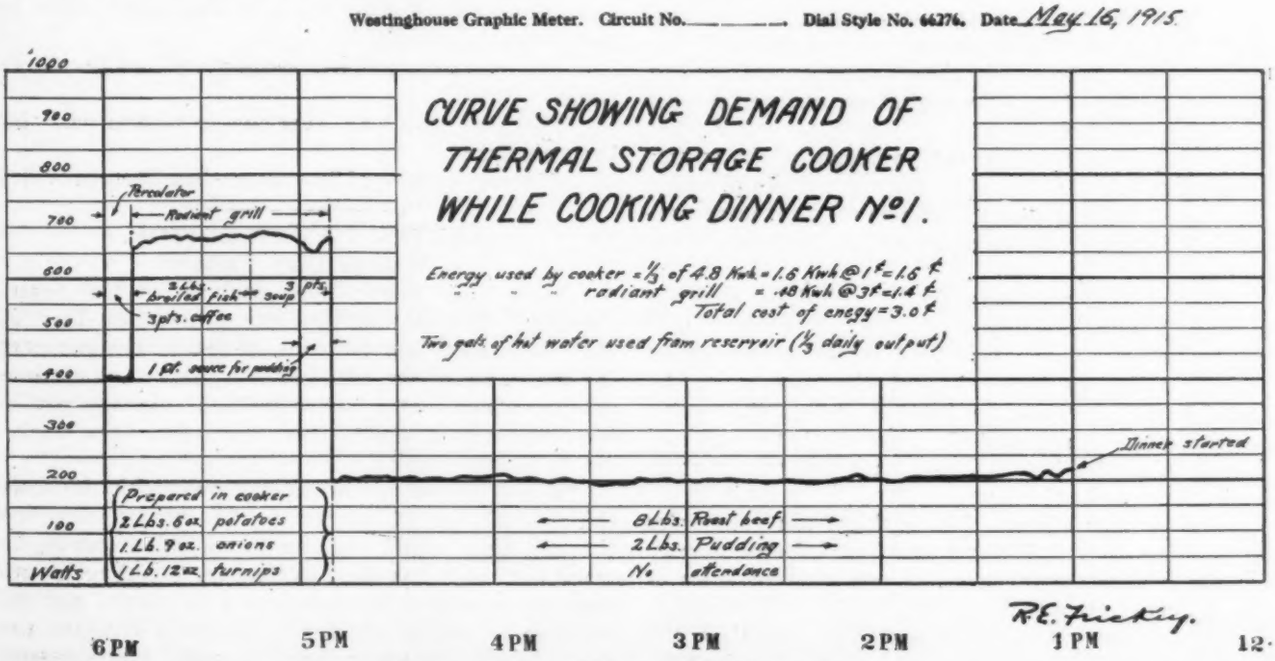
The cooker described has been thoroughly tested under actual working conditions. For comparison there was available a recent commercial report upon a range of the usual type manufactured by a prominent concern. In this report certain "standard" dinners and "standard" daily menus were listed. The energy used for each operation was given, as well as the load curves for the "standard" menus. The accompanying curve shows graphically the result obtained with the thermal storage cooker. Following is the data given for the standard range:

Article.	Quantity.	Minutes.	Watt-Hrs.
Soup	3 pts.	8	133
Broiled fish	2 lbs.	20	311
Roast beef	8 lbs.	148	1787
Potatoes	2 lb. 6 oz.	102	220
Onions	1 lb. 9 oz.	108	194
Turnips	1 lb. 12 oz.	109	180
Water	4 qts	26	448
Pudding	2 lbs.	43	278
Pudding Sauce	1 qt.	19	200
Coffee	3 pts.	20	150
Total		165	3901

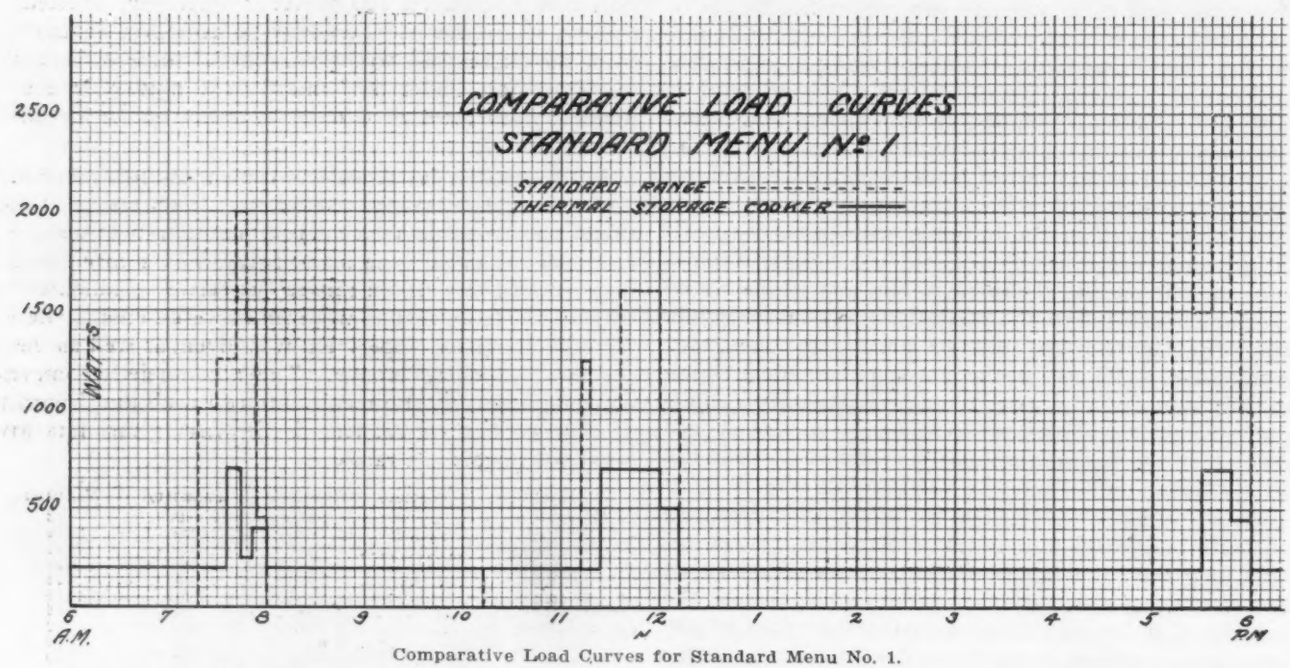
It is to be noted that only one gallon of water was provided by the range, while two gallons were obtained from the cooker. The curve is reproduced from the record of a graphic wattmeter connected to the cooker. For the part of the 24 hrs. not shown, there is a constant load of 200 watts.

In the curve for menu No. 1 the curve obtained while cooking the same menu upon the standard range is superimposed for comparison. The maximum demand of the range was 3600 watts, though the highest demand shown by the curves is 2875 watts. The maximum possible demand of the cooker is 700 watts.

For lack of space only one of the average daily menus is given:



Demand Curve While Cooking Dinner No. 1.



Comparative Load Curves for Standard Menu No. 1.

Menu No. 1 for Average Family.

Breakfast:	Amount.	Watt-Hrs.
Eggs on toast	5 eggs	209
Oatmeal	1½ pts.	153
Toast	12 slices	133
Coffee	1 qt.	162
Dinner:		
Pork Chops	8 medium	385
Fried Apples	1¼ lbs.	197
Boiled potatoes	2 lbs.	193
French toast	12 slices	171
Sauce for toast		98
Coffee	1 qt.	175
Supper:		
Omelet	5 eggs	101
Fried potatoes		248
Muffins	15	723
Tea	1 qt.	266
Preserves		
Total		3214

For the other two menus the total kw.-hr. consumption was reported as 4481 and 2875, respectively.

It should not be overlooked that the cooker produced five gallons of hot water in addition to food listed in the menus, while the range produced no water except that used in the cooking operations. In the report referred to, 448 watt-hrs. are charged against the production of one gal. of hot water, at 3c per kw.-hr., the water which was produced by the cooker would cost 6.7c if obtained by the method of the range. Also, it is thought that the menus selected were particularly favorable to the range and unfavorable to the cooker.

Some power companies on the coast have gone out after irrigation business on a flat rate basis of $50 per horsepower year. Watthour meters connected to such installations have showed the income to be about 1c per kw.-hr. In some instances the power companies have required the customers to purchase the transformers but in every case the power companies have built the lines.

The writer believes that, if the power companies are willing to sell 100 per cent load factor energy for the cooker described at 1c per kilowatt hour, a new era in electric cooking will result. The complete cooking equipment required will cost less than the cost of transformers, services, and meters required for a standard range. The central station should apply the money thus saved to capitalizing the investment for the consumer, that is, furnish the cooking equipment and charge a monthly rental to cover the interest, depreciation, etc.

This portion of the load which lies above the steady 200 watt demand is certainly a better load than the former cooking loads, and should have the most favorable rate for this class of service. Cooking rates, as low as 3c per kw.-hr. are common.

Going back to the causes which have held back electric cooking, it is seen that:

The high cost of apparatus is met by applying former cost of transformers, services, etc., to the purchase of the cooking apparatus for the consumer.

The inefficient application of heat is met by efficient apparatus and by the low rate permissible for the favorable service.

The heavy demand of the apparatus has been overcome.

The high peak load, overlapping station peak, has been abolished.

A cheap supply of hot water has been provided.

LETTER TO THE EDITOR.

Haiwee Dam Failure.

Sir:—Your history and analysis of the Seattle municipal dam blunder, in the Journal of May 22, 1915, is a most valuable contribution to the engineering literature of the day. It is a marked example of results, which occur under political management of large enterprises, such as have heretofore been worked out by private capital.

While legitimate municipal ownership is something which we all believe in, it is nevertheless true that the time is not ripe for municipal ownership to reach out, as it has done in Seattle, Los Angeles and some other places, in an endeavor to control and monopolize all public utilities. Because a city can successfully manage an ordinary domestic water system,

is no argument in favor of embarking upon the construction and management of such intricate utilities, as electric power plants, gas plants, railways, etc. Political management of public utilities has not yet reached a state of evolution which makes these things possible.

The case of the Seattle Cedar River dam finds a close parallel in Los Angeles. The Haiwee dam on the Los Angeles Aqueduct was constructed without making borings and investigations of the reservoir site, and has proved a failure. Although the Haiwee reservoir was completed about two and a half years ago, it has never been possible to fill the basin with water, because of the large leaks, and the slides, which have occurred on the face of the earthen dam.

The reservoir site is of volcanic origin on the east side and consists of an elevated mesa, formed by washings from the Sierra Nevada Mountains, on its west side. Under the dam no foundation, excepting porous rhylitic tufa, was discovered. The result has been that, as soon as an attempt was made to impound water, leaks both under the dam and through the volcanic terrain consisting of tufa and other porous volcanic rocks, became both marked and dangerous.

The water level in the surrounding desert has been raised in wells to a height running up to 90 ft. above the former level of water in these walls, and large streams of water are pouring from the porous deposits along the easterly sim of the reservoir. This is the case with the water raised to a level of only about one-half the height to which the dam was constructed.

Work has been going on steadily since the completion of Haiwee reservoir two and one-half years ago, with the object in view of finding and stopping the leaks. Trenches have been dug to place cut off walls, tunnels have been run in the formation, in an endeavor to locate the leaks, and other expedients have been resorted to without success.

Intelligent investigations and borings at the Haiwee dam site and along the margin of the reservoir basin, would have condemned both as unsafe, just as would have been the case in Seattle.

The only difference between the Los Angeles situation and that in Seattle is in the following particulars:

1. The Haiwee reservoir is located some 200 miles from the city of Los Angeles, on the desert near Owens Lake, and few people know anything about the actual conditions. The fact has, therefore, been kept from the public and politicians have been able to safely conceal what has been going on, and to contradict the truth, when reported by the few observers, who have seen it.

2. The Los Angeles aqueduct is not needed, because the city has an ample water supply without it; and the work begun on the municipal power plant has been stranded on the rocks of political inefficiency, so that it is no nearer completion than it was three or four years ago, and no water need be delivered to operate it.

These facts cannot be made known to the general public in Los Angeles, because the proprietors of the leading newspapers are interested in the lands of the San Fernando Valley, of which 120,000 acres with less than 3000 population, have just been annexed to the city of Los Angeles. The fact is too well known to need repetition, that the aqueduct was built to irrigate these lands and thereby incidentally enrich their owners, and, until there is an actual demand for water for that purpose the promoters of the Haiwee dam, who are in charge of municipal water department of the city of Los Angeles, can successfully escape exposure.

Very truly,

F. C. FINKLE.

Los Angeles, Cal., May 28, 1915.

UTILIZING WATER POWER IN RUSSIA.

The administration of the waterways of the interior of Russia has prepared an explanatory note in regard to the project of law regulations concerning the utilization of water power. The note mentions the latest technical improvements achieved in this direction during the last ten years. The utilization of water power is of special importance, inasmuch as the electric energy obtained by these means can be transmitted to certain distances. Hydroelectric power can be used in all kinds of industries where motive power is used; it is of special importance in mining, in the electrochemical and metallurgical industries, and in the manufacture of a number of articles important in agriculture.

Of the greatest importance, however, is the use of hydroelectric power in the exploitation of ways of communication, as the change from steam to electricity on railways becomes a necessity in many cases even for long distances. The 24 large rivers of European Russia, not including the Caucasus, can furnish 1,000,000 horsepower. The hydrauiic resources of Siberia have not yet been ascertained.

The total supplies of water power in Russia are estimated by some investigators at 12,000,000 horsepower, in comparison with the total supplies of Western Europe, which are estimated at 34,000,000 horsepower.

Western Europe as well as the United States is covered with a network of hydromechanical installations, which, in the principal countries of Europe, produce more that 3,500,000 horsepower. In Russia a considerable number of applications for concessions have been received during the last 20 years, which circumstance has proved the necessity of utilizing the water power; but the granting of concessions, as well as any activity on the initiative of the government, was impeded by defects in the Russian law regulations.

Even in cases when the exploitation of water power may be given over to private enterprise, it is always closely connected with the interests of the state and the population. The right of exploitation conferred on a private individual places him in a position to control the entire industry of the district, which, under the existing conditions, the government believes should belong to it. The right of exploitation of the water power, therefore, may be given to private individuals only on condition that it will be under the control of the state.

INDUSTRIAL USES OF FUEL OIL

BY F. B. DUNN.

Fuel Oil for Naval and Maratime Purposes.

[Concluded.]

Most types of mechanical atomizers will produce a fine spray of oil; the important problem is to secure a furnace design and arrangement which will insure proper distribution of the air. A test was recently conducted on the steam yacht "Idalia." This vessel is fitted with a Babcock & Wilcox marine boiler, containing 2560 sq. ft. of heating surface. A simple and effective system of induced draft fans was installed, capable of giving a suction in the uptake of 1 to 1¼ in. of water, and in addition to this a forced draft fan was set up on the dock and connected by means of a flexible duct to a sheet casing enclosing the oil burners in front of the boiler. The tanks and scales for weighing the oil and water and the oil pump and heater were set up on the dock and connected to the vessel by means of flexible pipes, the regular feed pump of the plant being used for taking weighed water from the filter box. The engines and other auxiliaries were not in use, the steam discharged to the atmosphere through a muffler arranged to maintain regular working pressures on the boiler. All precautions were taken to prevent leaks and secure accurate data. Fifteen evaporative tests were made, under a variety of conditions, the results being given in the table below. Between these tests, considering experimenting was done with various air-distributing arrangements, flat burners, etc. The best performance was an evaporation of 7.47 lb. of water per square foot of heating surface per hour from and at 212 degrees, F., at an efficiency of 82.8 per cent at a rate of combustion of 6.17 lb. of oil per cu. ft. of furnace volume per hour with a draft in the uptake of .84 in. of water

Idalia Tests.

Observations.	Oct. 20	Oct. 29	Nov 5	Nov. 10	Nov. 25	Dec. 5	Dec. 17
Duration of test in hours	3	3.5	3	1	3	2	2
Steam pressure in pounds	228	225	223	232	226	222	225
Temperature of feed water (F.)	60	95	98	89	52	47	48
Superheat in steam (F.)	31	30	44	47	71	57	61
Pressure of oil at burners	239	228	222	222	193	193	196
Temperature oil at burners	190	206	195	195	214	207	206
Oil burnt per hour (lbs.)	749	794	782	1,202	1,150	1,039	1,163
Oil per burner per hour	187.3	176.1	195.4	300.5	287.5	259.8	290.8
Oil per cubic foot of furnace volume per hour	5.31	3.74	4.15	6.38	6.11	5.52	6.17
Oil per square foot heating surface per hour	.293	.275	.305	.470	.449	.406	.454
Draft in uptake (in.)	—.43	—.39	—.72	—.85	—.94	—.97	—.84
Draft in furnace (in.)	—.18	—.17	—.36	—.33	—.72	—.50	—.25
Blast at burners (in.)	.00	00	.00	.00	*.67	.00	.00
Temperature of air (fireroom)	86	101	71	99	88	67	70
Temperature of waste gases	504	546	550	654	639	574	573
Analysis of waste gases—% CO_2	13.2	10.2	8.2	8.3	9.4	Appar-	10.9
Analysis of waste gases—% O	3.0	5.5	8.5	8.2	7.8	atus	6.1
Analysis of waste gases—% CO	0.0	0.0	0.0	trace	0.0	not	0.0
Analysis of waste gases—% N	83.8	84.3	83.3	83.5	82.8	working	83.0
Water evaporated from and at 212 degrees (F.)	11,502	10,806	9889	16,137	16,225	16,524	19,121
Water per sq. ft heating surface from and at 212° F.	4.49	4.22	3.73	6.30	6.34	6.45	7.45
Water per lb. oil from and at 212 (F.) in lbs.	15.36	15.4	12.65	13.42	14.11	15.90	16.45
Specific gravity of oil	.934	.934	.934	.935	.935	.935	.935
Flash point of oil (F.)	220	220	220	220	224	224	224
B.t.u. per lb. of oil	19,021	19,021	19,021	19,021	19,174	19,174	19,174
Efficiency, per cent	78.0	77.8	64.2	68.1	71	80.1	82.8

The above tests were made under a Babcock & Wilcox boiler with superheater H. S. 2,560; S. H. S. 340; Peabody mechanical burners; Texas oil.

Many shipowners having steamers plying between countries where oil is cheap and coal high, or vice versa, have equipped their steamers to use coal during one part of the voyage and oil during the return. A vessel so equipped is the Japanese liner Tenyo Maru. On this ship six boilers burn coal, and six oil, on the run between San Francisco and Yokohama; between Yokohama and Hong Kong all twelve boilers burn coal. Thus for thirty days oil is burned under six boilers and coal under the other six, while for ten days coal is burned under all twelve boilers.

In order to determine the available cargo space gained by this method, let us assume the following data: Ninety tons of oil used each 24 hours for 30 steaming days = 2700 tons of oil consumed. Taking oil at 15 deg., B., or 5.917 bbl. of oil per ton = 15,970 bbl. of oil, and assuming four barrels of oil equivalent to one ton of coal, would require 4000 tons of coal. Figuring coal at 42 cu. ft to the ton would require 168,000 cu. ft.; while the oil, at 5.62 cu. ft. per barrel, would require about 90,000 cu. ft. Thus a saving of 78,000 cu. ft. of space is effected, which, at 40 cu. ft. per ton of cargo, would accommodate 1950 tons of freight.

Other tests were made on the United States battleship Wyoming with coal as fuel, oil as fuel, and a combination of coal and oil. The oil was sprayed over the coal fire, a flat flame being secured by adjusting the admission of air. The capacity of the boilers can be increased by using oil in this manner, but efficient results are obtained only when either fuel is used alone.

The oil pipe line for the Valley Pipe Line Company of California, a subsidiary of the Shell Royal Dutch Company, which was designed and is being built by Sanderson & Porter, was placed in successful operation on May 15th for a length of 47 miles. This line is 170 miles long, extends from the Coalinga oil fields to a tidewater terminal near Martinez in San Francisco Bay, and will have a carrying capacity of 2500 barrels per day. The storage capacity at the pumping stations now in operation on this first section of the line amounts to 225,000 barrels, which is thus made immediately available for the storage of surplus production.

DISCUSSION.

Pacific Coast Electro-Chemical Possibilities.

(Conclusion of discusssion on paper presented before San Francisco Section American Institute of Electrical Engineers, March 26, 1915, and published in this journal March 27, 1915.—The Editor.)

[Concluded.]

The Chairman: What is the principal compound of nitrogen?

D. Mosher: Ammonia is one of the compounds and nitric acid is the other. Of course, there are a very large number, both inorganic and organic. For instance, amide is almost the same as ammonia, i.e., it has two atoms hydrogen united to one of nitrogen, instead of three as in the case of ammonia. The reason they call it cyanamide is because it is a combination, on slaking the compound, of amide and cyanogen, the same as ammonium cyanide is a combination of ammonia and cyanogan.

The inorganic nitrogen compounds most mentioned are ammonia and nitric acid. Cyanamide will actually be converted into organic nitrogen products in the soil, as urea. The inorganic cyanogen compounds are poisonous to the soil.

The original idea was to produce cyanides in a cheap way direct from air nitrogen. Instead they have created a large fertilizer industry. Mr. Myers can give you the total tonnage. They have a large plant manufacturing 16,000 tons cyanamide in Japan, per year, notwithstanding that, Japan imports an immense amount of ammonium sulphate for agricultural purposes.

The way to figure readily is that ammonium sulphate contains 25 per cent of real ammonia or 20 per cent "fixed" nitrogen. The market value of ammonium sulphate is $60 per ton, so it is worth, off-hand, 15c per pound for the "fixed" nitrogen. The method best adapted to this coast will be the furnace methods and only under the cheapest power conditions will be advisable to install the electric flame method of nitrogen fixation. In the Pauling system, which is worked out on the horn lightning arrester principle, the efficiency is only 3 per cent. It is practically nothing but a heat producing method instead of a real chemical process from the standpoint of efficiency. In other words, if the efficiency of any of these nitrogen fixation methods could be brought up to 70 per cent or 80 per cent, the Chilean nitrate deposits and all the coal and coke ammonia would become almost valueless on account of the price at which the product could be sold. Of course, electrical engineers appreciate the fact that $3 or $4 power is really no price for power from any standpoint; and while Mr. Halloran has shown in the Journal of Electricity, Power and Gas that the Speel River project will produce power at $6 per kilowatt year, it does not seem that any of the Pacific Coast companies will want to convert any of their power into any product at that figure. But we do not need that price for nitrogen fixation by any of the alkaline earth or furnace methods, as the efficiency is four times as great as it is in the electric flame method.

In the Serpek process they fix the nitrogen at about 3200 degrees F. and then they get a very valuable by-product in pure alumnia for the manufacture of aluminum. Without figuring that the aluminum industry will ever be established on the coast, for the reason that the Niagara Falls companies are pretty well entrenched, it seems that the best proposition out here will be a combination of some cheap mineral methods such as I mentioned, either magnesite, or possibly a mixture of lime and bauxite together with carbon. The whole method is simpler than it would appear at first hand.

You gentlemen are undoubtedly aware that there is a liquid air plant in operation in Oakland for the production of oxygen from the air, and they are wasting something like three or four tons of nitrogen every day right across the bay. That would produce about five tons of ammonia, and ammonia is expensive. It is worth 28c a pound for use in ice machine work. I figured some years ago that an industry for the production of ammonia by synthesis would be very possible here; while Professor Eyde, one of the successful pioneers in nitric acid production from the air, came out here and wanted the power companies to give him $6, $8 or $10 power per year. They did not consider the proposition inviting.

The Chairman: Would it be possible to combine the manufacture of oxygen with one of these other chemicals?

D. Mosher: That is what the Linde Company is doing. It is selling its oxygen at 2c per cubic foot and the nitrogen goes to waste. Nitrogen goes to waste in so many industries.

One thing I would like to have Mr. Myers bring out in his paper tonight. In a recent issue of the Engineering News the cyanamide plant at Niagara Falls was fully illustrated and described. They use the liquid air plant for producing 40 tons of pure nitrogen per day, and then they have a number of carbide furnaces; the nitrogen fixation is the simplest part of it all, but according to the figures stated, they have over $3,000,000 invested. The idea is to get around this complicated, expensive and delicate system. Sulphide ores are roasted for less than 50c per ton and nitrogen fixation should be almost as simple. It is just the parallel of ore roasting but oxygen must be excluded.

Harris J. Ryan: Are we right in understanding that the progress of this industry is such then, that the electric flame method would not be likely to hold its own on the coast? Are these other and newer and more efficient methods likely to be the ones that would be successful on the Pacific Coast?

Romain Myers: Yes, that is correct.

Mr. Bucher: I understand that companies that produce oxygen are letting the nitrogen go to waste, and companies that produce nitrogen products let the oxygen go to waste. I would like to find out whether there is some method by which both could be utilized. It seems to me we could use the oxygen in its free state, while we cannot use the nitrogen until it is fixed. There is another question I would like to ask in regard to the details of processes in Sweden or Norway, where I understand the nitrogen methods have been most successful,—whether they operate on the off-peak load, and what price they pay, and the method they use, and the comparison of cost of labor there and here?

Romain W. Myers: As far as the systems in Norway and Sweden are concerned, I don't think there are any of them that operate on the off-peak load. The only one that I am familiar with at all that works that way is in Milan, Italy, and that a flame system.

As to the cost of labor, I do not know. I know that in the Birkeland-Eyde system at Norway, in that immense plant they have a few workmen. The element of labor is reduced to a fine point, so it is not really a question of labor. They practically take care of themselves. I think one man could take care of several furnaces that would run a thousand kilowatts each. In the above plant there are about 100 workmen handling 100,000 kw. The plants in Norway and Sweden utilize at the present time about 250,000 h.p. in the production of nitrogen. Of course the cyanamide industry has a number of plants scattered through Europe; and the one that we have at Niagara Falls produces 64,000 tons a year, and various other ones in Europe, which make a total of 333,000 tons per year of cyanamide among 15 or 20 plants. They have had a vigorous growth in the last few years; more so than the other systems.

The Chairman: I should like to ask Mr. Myers if in Norway and Sweden, where a great deal of power is used in this process, whether the plants are not located very close to the power houses, and the investment in transmission is a very small incident?

Romain W. Myers: Yes, they are short distances,—3 to 16 miles.

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Co-operative Water-Power Permits

After years of bitter misunderstanding between federal and state authorities regarding the jurisdiction over water rights many Western states seem now to be nearing a solution that will bring relief in a great measure. The issuance of water-power permits upon Forest Reserves has been most annoying in the past.

Since the courts have generally accepted the ownership of waters as vested in the several states it has always been necessary for the appropriator to seek the proper state channels to secure title to the use of the water. On the other hand in order to use the water for power purposes, when the domain of the National Forests was to be trespassed upon the permission of the federal authorities has also been necessary.

In later years both state and federal authorities have sent out investigating parties before issuing the permit. This investigation is always instituted to ascertain the real merit of the appropriation. Since there is only one real right or just appropriation it is rather remarkable to relate that not infrequently, in face of this fact, one or the other—the state or the federal control—decided affirmatively and the other negatively. It is easy to appreciate the uncanny position of the appropriator thus being in mid air as it were—neither here nor there.

It is gratifying to note that the commonwealth of Oregon under the leadership of a broad gauge state engineer, has decided upon co-operation with the U. S. Forest Service in the issuance of all permits.

While many of us have definite and distinct ideas favoring complete state control of water power sites as opposed to federal jurisdiction—still the all important point is to be able to receive a just and impartial hearing on the merits of a case at issue and to know that where the thing is settled no further blockage is to be encountered.

It is to be hoped that many of the other differences and hindrances that arise in this conflicting or overlapping of jurisdiction may in the near future be similarly effectively adjusted through mutual co-operation.

A Fallacy in Municipal Ownership

Some years ago it was a comparatively easy matter to finance hydroelectric enterprises. In spite of the fact that due to the evolution of the art in hydroelectric design and operation this branch of commercial activity has now been put on an assured basis both in construction costs and reasonable financial return, still capital is very loathe to undertake new enterprises of this nature at the present time.

There is a deeper reason for this than the mere stringency of the times. Perhaps the greatest factor that has contributed to this depression in hydroelectric activity is the tightening of utility regulation to such a point that the return allowed, while reasonable for certain types of income producing investments, is nevertheless not sufficiently attractive to induce new

capital to enter the field when other channels are available that offer better return with less risk involved.

The people of the West have seemed slow in grasping this real and justifiable reason for apathy in new work under private financing and as a consequence a campaign of municipal ownership was launched and successfully carried through in many municipalities —during recent years—that is the campaign was successful in so far as vast sums of money were invested by the various municipalities in hydroelectric enterprises.

In the ideal is is perhaps to be admitted that municipal or state ownership is the sane and economic solution of hydroelectric generation and operation. The task is a huge one, however, and the political issues that invariably creep into the present day evolution of the municipally owned power plant are often most distressing and of severe financial loss to the people at large.

Such is the case in two Western cities at the present time. In one instance competent engineers were employed and definite dangers were cited by them which augured against the possible usefulness of the proposed dam development and yet in face of this the political regime in power proceeded to develop the dam site without taking the precautionary measures of investigation that were urged by this committee of experts. As a consequence it now seems that an exceedingly large investment is jeopardized.

Such an instance as this would never happen in private development work, for the modern corporation is too well stocked with keen alert managers and ever zealous investors to allow such a disaster to happen to their own money. But how true it is that in the heat and strife of frenzied politics, with a bag of money belonging to an apparently intangible and non-visible owner the evolution of municipal development often runs amuck.

The overbonding of American cities is a danger that should well be guarded against, for the destruction of a city's credit in unwarranted blunders undoubtedly causes setbacks to the development of a community that may take years to eradicate, for the unsuccessful project is not only a loss in itself but the privately owned utilities having been limited in operation or even driven from the field are not at such critical times immediately available to assume the tasks of commercial necessity brought to life by the ineffectiveness or failure of the municipal plant.

Agricultural Machinery Laboratory

Much is being said during these months of international strife concerning the great world expansion that will be made possible for American engineering enterprise at the cessation of hostilities. Undoubtedly vast opportunities hitherto unexploited will be presented and with wise and careful forethought these opportunities may be converted into real substantial blessings by bringing about a reasonable increase in our foreign outlet for manufactures and engineering constructive effort. Especially will these opportunities present themselves to Western men, for their familiarity with conditions of recent gigantic development west of the Rockies will enable them to judge with the eye of a connoisseur the real advantages that are presented in the great Pan-Pacific territory now open for American aggrandizement.

We must not lose sight of the fact, however, that while trade increases the wealth and glory of a country, still the real strength and stamina of a nation are to be found among the cultivators of the land. This truism applies not only to men but to things. Thus, the power company that depends solely upon the industrial and trade prowess of a nation is always subject to the violent fluctuations of financial depression, while that power company that has built its greatness upon the agricultural output of a community has indeed built upon the rock that the storms and the winds of financial frenzy can not disturb, for agriculture not only gives riches to a nation but actually creates them.

The need for more intensive farming in the West is constantly being felt. Practically every variety of vegetation known under heaven can be grown somewhere within the confines of this favored section. Nevertheless to develop its productive yield to a maximum, advantage must be taken of the most efficient agricultural machinery and appliances as well as of the most improved scientific methods in soil study.

A question, then, of intense economic importance to the agriculturist and to those interested in hydroelectric development is the determination on the broadest lines possible of just what constitutes efficient agricultural machinery and appliances. A research laboratory for determining such data based upon commercial practice has long been the dream of the agricultural countries of the world. France has hitherto taken the biggest strides in this direction but her attempt ended by simply displaying on a working basis the improved methods of agricultural machinery in actual operation.

Due to the wisdom of the last state legislature, however, acting upon the initiative of the Regents of the University of California a research laboratory is to be established at Davis, California, to study the commercial efficiencies and adaptability of all types of agricultural machinery, unhampered and unfettered by any untoward influence.

This unique laboratory thus, in truth, becomes a laboratory for increasing electric power consumption in the West, for it is now a well established fact that the agriculturists distributed over that enlightened section are only too glad to avail themselves of the opportunty to increase their power consumption by installation of costly apparatus if only they can see the return to them in ultimate increased yield per acre.

Managers of power companies and others interested in the hydroelectric development of the West will do well not only to casually follow the accomplishments of this new branch of research endeavor but actually give it their active support both by an occasional visitation and especially by promulgating in their respective distribution areas the information that will become available from time to time in the course of research study at this laboratory.

PERSONALS

H. R. Noack, president Pierson, Roeding & Company, is at Los Angeles.

Holton H. Scott, president of the National Electric Light Association, is at San Francisco.

F. F. Skeel, manager of Crouse-Hinds Company, Chicago, is at the Yosemite National Park, Cal.

F. C. Todd of the Portland office of the Pacific States Electric Company, is at San Francisco.

F. H. Leggett, manager Western Electric Company, San Francisco, is on a business trip to Portland and Seattle.

Stuart Rodgers, representing Clark C. Van Fleet Electric Company, Santa Rosa, was a recent visitor at San Francisco.

J. M. Kinkaid, manager of the Key City Light & Power Company at Port Townsend, Wash., was a recent visitor at Seattle.

W. F. Hynes, manager of the apparatus department of the General Electric Company at Portland, was a recent Seattle visitor.

W. R. Lyall, Pacific Coast representative of the D. &. W Fuse Company, San Francisco, has returned after a several weeks' trip through Utah.

Geo. H. Ross of the Electric, Railway and Manufacturers' Supply Company, San Francisco, is on an extended trip through Northern California.

A. E. Wishon, assistant general manager of the San Joaquin Light & Power Company, Fresno, Cal., recently spent several days at San Francisco.

W. Brewster Hall, representative for Pass & Seymour Company, San Francisco, Cal., has returned from a business trip through the Pacific Northwest.

Thomas H. Bibber has resigned as representative for Edwards & Co. to become Eastern sales manager for The Adams-Bagnall Electric Company of New York City.

F. R. Fantom, formerly of the Washington Water Power Company, Spokane, Wash., has become associated with the Baruch Electric Controller Corporation at San Francisco.

F. J. McConnell, manager of the Seward Peninsula Power Company at Nome, Alaska, is visiting Seattle on his way back to Nome after an extended trip throughout the Eastern States.

C. V. Aspinwall, of the railway and light departments of the Westinghouse Electric & Manufacturing Company, has returned to Seattle from an extended triy throughout Southwestern Washington.

C. L. Huyck of the San Francisco office, Western Electric Company, and **E. R. Murray,** representative of the same company in the San Joaquin Valley, Cal., have returned after an extended trip through Sonoma County, Cal.

James F. Kinder of Portland, Ore., representative of the Wise-Harold Electric Company, New Philadelphia, Ohio, is at San Francisco, and is anticipating representing the Dover Manufacturing Company on the Pacific Coast.

Tully R. Cornick, high tension transmission line contractor, has transferred his office from Vancouver, B. C., to Peoples building, Pittsburgh, where he has contracts with the Duquesne Light Company.

F. P. Wilson, superintendent of construction for the General Electric Company at Schenectady, N. Y., was a recent Seattle visitor, en route to Schenectady from the Panama-Pacific Exposition at San Francisco.

H. E. Plank, agent in charge of the Seattle office of the General Electric Company, is at San Francisco, where he will visit the Panama-Pacific Exposition, and also attend the National Electric Light Association convention.

George W. Elliott, master of transportation for the National Electric Light Association, is in direct charge of the Red Special whose 165 passengers have been visiting Los Angeles, San Diego and Yosemite Valley during the past week.

W. H. Robinson, chief engineer of the Westinghouse Lamp Company, New York, arrived at San Francisco during the week and leaves shortly with **W. C. Wurfel,** manager of the compnay at San Francisco for a trip to Los Angeles and southern California.

Chas. T. Johnson, president Dover Manufacturing Company, Canal Dover, Ohio, who has been spending some time at San Francisco, returned from a trip to Los Angeles, Cal., enroute to Portland and Seattle, which territory be expects to visit in the near future.

Charles F. Scott, professor of electrical engineering at Sheffield Scientific School of Yale University and past president of the American Institute of Electrical Engineers, will give the principal address at the dedication of the new Mechanics' Arts Bldg., State College of Washington, Pullman, Wash., on June 9th.

J. E. Woodbridge, resident engineer Ford, Bacon & Davis, **J. P. Jollyman,** electrical engineer Pacific Gas & Electric Co., and **W. G. Vincent,** valuation engineer Pacific Gas & Electric Co., have been elected members of the executive committee of the San Francisco Section of the American Institute of Electrical Engineers, the holdover members being **A. H. Babcock** and **Guy L. Bayley.**

Advance Registration for N. E. L. A. Convention.

Abbott, W. L., Commonwealth Edison Co., Chicago, Ill.
Alexander, E. D., Pres., Tri County Lt. & Power Co., Dixon, Ill.
Alexander, E. W., Gen. Mgr., Charleston-Dunbar Trac. Co., Charleston, W. Va.
Aller, H. L., Mgr., Pacific Gas & Elec. Co., Phoenix, Ariz.
Almert, Harold, Consulting Engr., Chicago, Ill.
Almert, Mrs. Harold.
Alvord, R. M., General Elec. Co., San Francisco, Cal.
Amsden, A. E., Salesman, Denver Gas & Elec. Lt. Co., Denver, Colo.; Bellevue.
Anderson, A. J., Sangamo Elec. Co., Springfield, Ill.
Anderson, Mrs. A. J.
Anderson, L. C., Gen. Mgr., Middletown Gas & Elec. Co., Middletown, Ohio.
Anderson, Mrs. L. C.
Anderson, Miss Mary Balentine.
Andrus, Raymond J., Vice-Pres. & Gen. Mgr., Northwest Elec. & Water Wks., Montesano, Wash.; Olympic Club.
Atkins, Wm H., Gen. Supt., Edison Elec. Illg. Co. of Boston, Boston, Mass.; St. Francis.
Atkins, Mrs. Wm. H.

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Lloyd, W. F., Philadelphia Elec. Co., Philadelphia.
Lloyd, Mrs. W. F.
Logan, Harry B., Pres., Dossert & Co., N. Y., City; St. Francis.
Logan, Mrs. Harry B.
Love, J. C., Asst. Treas., Pac. Gas & Elec. Co., San Francisco.
Lunn, Guy W., Commonwealth Edison Co., Chicago, Ill.; Bellevue.
Lunn, Mrs. Guy W.
Lusk, Ward, Elko Lamoille Pr. Co., Elko, Nevada.
Lyons, B. F., Vice-Pres. & Gen. Mgr., Beloit Water, Gas & Elec. Co., Beloit, Wis.

McArthur, Lewis A., Pacific Power & Light Co., Portland; The Haven.
MacCalla, C. S., Vice-Pres. & Gen. Mgr., The Washington Water Pr. Co., Spokane, Wash; St. Francis.
MacCalla, Mrs. C. S.
Magruder, H. W., Pres. & Mgr., Liberal Light, Ice & Power Co., Liberal, Kan.
Mann, W. L., Gen. Mgr., York Haven Water & Power Co., York Haven, Pa.
Mann, Mrs. W. L.
Manser, John, Sec.-Treas., Antigo Electric Co., Antigo, Wis.
Manwaring, A. H., E. E., Phil. Elec. Co., Philadelphia, Pa.; St. Francis.
Manwaring, Mrs. A. H.
Manwaring, W. A., Philadelphia Elec. Co., Philadelphia, Pa.
Marshall, A. Jackson, Sec. Electric Vehicle Assn. of America, New York City.
Martin, J. C., Pacific Power & Light Co., Portland, Ore.
Martin, T. C., Sec. National Elec. Lt. Assn., New York City; St. Francis.
Mather, Frank T., Peninsular Elec. Lt. Co., Detroit, Mich.
Mather, Mrs. F. T.
Mateer, Ross B., So. Sierras Power Co., Riverside, Cal.
Mateer, Mrs. Ross B.
Matthews, George, Auditor, Danbury & Bethel Gas & Elec-Lt. Co., Danbury Conn.; Bellevue.
Maxwell, M. P., R. Thomas & Sons Co., N. Y. City.
Mayer, J. L., American Ironing Machine Co., Chicago, Ill.; Exposition Grounds.
McBride, B. G., Mgr., Elko Lamoille Pr. Co., Elko, Nevada.
McBride, Mrs. B. G.
McCall, Joseph B., Pres., Philadelphia Elec. Co., Philadelphia, Pa.
McCall, Mrs. Joseph B.
McCall, Miss Lenore Adah
McClelland, R. J., Electric Bond & Share Co., New York City; St. Francis.
McConnaughy, H. G., Sec.-Treas., Exposition Committee, N. E. L. A., New York City; St. Francis.
McConnaughy, Mrs. H. G.; St. Francis.
McDonald, W. D., Westinghouse Elec. & Mfg. Co., Seattle, Wash.; Clift.
McDonald, Mrs. W. D.; Clift.
McDougal, J. H., Commercial Dept., P. G. & E. Co.; S. F.
McGill, T. J. Westinghouse El. & Mfg. Co., Chicago, Ill.; Palace.
McKnight, W. M., So. California Edison Co., Redondo Beach, Cal.
McLaren, W. H., Gen. Elec. Co., Schenectady, N. Y.
McLaren, Mrs. W. H.
McLaughlin, J. J., Pub. Serv. Elec. Co., Camden, N. J.
McNamara, J. W., Peninsular Electric Light Co., Detroit, Mich.; St. Francis.
McNamara, Mrs. J. W.
Meinema, A. J., Electric Appliance Co., San Francisco.
Maynard, F. G., Supt, San Jose Dist., P. G. & E. Co. San Jose. Cal.
Mel, W. Bartlett, Pac. Gas. & Elec. Co., San Francisco.
Merritt, Wm. H., Vice-Pres. & G. M, Fremont Gas. Electric Lt. & Power Co., Fremont, Nebr.; St. Francis.
Merritt, Mrs. Wm. H.
Meyer, Edward B., Pub. Serv. El. Co., Newark, N. J.; St. Francis.
Meyer, Mrs. Edward B.; St. Francis.
Millar, Preston S., Gen. Mgr., Elec. Testing Laboratories, N. Y. City; Palace.
Miller, Alvin A., Westinghouse Elec. & Mfg. Co., Seattle, Wash.; Clift.
Miller, Mrs. Alvin A.; Clift.
Miller, W. C., Peninsular Elec. Lt. Co., Detroit, Mich.; St. Francis
Miller, Mrs. W. C.; St. Francis.
Miser, Mrs. Emma H.; Palace.
Mitchell, George F., Commonwealth Edison Co., Chicago, Ill.; Palace.
Monahan, Edward C., Mgr., San Joaquin Dist., P. G. & E. Co., Stockton.
Moloney, Thomas O., Presi. Moloney Elec. Co., St. Louis, Mo.
Moloney, Mrs T. O.
Montgomery, George A., Vice-Pres., G. M. Lincoln Gas & Elec. Co., Lincoln, Nebr.; St. Francis.
Montgomery, Mrs. George A.; St. Francis.
Moore, C. C., Pres. Panama-Pacific Exposition, San Francisco.
Morphy, A. E., Asst. Sec., Southern California Edison Co., Los Angeles: St. Francis.
Mosher, H. N. Supt. Station C, P. G. & E. Co., Oakland, Cal.
Mountain, John T., Commonwealth Edison Co., Chicago, Ill.; Palace.
Munro, W. N., Engr., Station C, P. G. & E. Co., Oakland, Cal.
Munroe, Chas. C., Peninsular Elec. Lt. Co., Detroit, Mich.; Clift.
Munroe, Roy G, Denver Gas. & Elec. Lt. Co., Denver, Colo.
Munroe, Mrs. Roy G.
Murphy, George R, Pierson-Roeding Co., San Francisco.
Musil, Louis F., Cities Service Co., N. Y. City; Clift
Musil, Mrs. Louis F.; Clift.
Mustard, John, Phila. Mgr., Wagner El. & Mfg. Co.; St. Francis.
Mynard, C. E., Asst. Treas. Gt. Western Pr. Co., San Francisco.
Myrtle, F. S., Mgr., Pub. Dept., P. G. & E. Co., San Francisco.

Nelson, Miss J. A.; St. Francis.
Neely, M. L., Mgr., Fresno Dist. P. G. & E. Co.
Neumuller, Walter, New York Edison Co., New York City; St. Francis.
Newbert, L. H., Mgr., Sales Dept., P G. & E. Co., San Francisco.
Newman, A. L., Sec.-Treas., Arkansas City Gas & Elec. Lt. Co., Arkansas City, Kan.
Niesz, Homer E., Commonwealth Ed. Co., Chicago, Ill.; Palace.
Niesz, Mrs. Homer E.; Palace.
Nims, F. D., Asst. Gen Mgr., Olympic Pr. Co., Port Angeles, Wash.
Noble, G. O., Westinghouse Elec. & Mfg. Co., Los Angeles, Cal.; Clift.
Norman, Attilla, Vice-Pres. & G. M., Oregon Pr. Co., Eugene, Or.
Norman, Mrs. Attilla.
Northmore, E. R., Los Angeles Gas & Electric Corp.
Nott, L. A. Standard Underground Cable Co., San Francisco.

O'Brien, W. J., Sec.-Treas. Helena Gas & Elec. Co., Helena, Ark.
O'Connell, Martin J., Warrenton El. Lt. & Ice Co., Warrenton, Va.
O'Connell Mrs. Martin J.
Onken, W. M. Jr., Electrical World, N. Y. City; St. Francis.
Orr., R. S., G. M. Duquesne Light Co., Pittsburgh Pa.; Fairmont.
Osborn, George C., Edison Lamp Wks. of Gen. Elec. Co., Harrison, N. J.; Palace.
Osborn, M. C., Washington Water Power Co., Spokane, Wash.
Osborn W. E. Mgr. Yolo Dist. P. G. & E. Co. Woodland, Cal.
Ott, B. F., Sec-Mgr, Franklin Elec. Co., Franklin, Pa.; Palace.
Overman, W. L., Hughes Electric Htg., Co., Seattle, Wash.
Owens, Westinghouse Elec. & Mfg. Co., Detroit, Mich.; Clift.
Oxtoby, Jas. V., Peninsular Electric Light Co., Detroit, Mich.

Palmer, George Q., Pres., Alberger Pump & Con. Co., N. Y. City.
Pape, J. H., Supt. of Elec. Dist., P. G. & E. Co,, Berkeley, Cal.
Parker, George F., G. M. The Electrical Show, N. Y. City; St. Francis.
Parker, Mrs. George F.; St. Francis.
Paterson, A. B., G. M. Meridian Lt. & Ry. Co., Meridian, Miss.; St. Francis.
Patterson, Miss Charlotte E.; Stewart.
Peaslee, W. D., Prof. of E. E., Oregon Ag. College, Portland, Ore. Stewart.
Peck, Henry W., V. P. & G. M. Schenectady Illg. Co., Schenectady, N. Y.; Fairmont.
Peck, Mrs. Henry W.; Fairmont.
Perry, J. W., Gen. Mgr., Elec. Dept., H. W. Johns-Manville Co., N. Y. City.
Perry, Mrs J. W.
Peterson, Edward, Treas.-Mgr., Crookston, Water Wks. Pr. & Lt. Co., Crookston, Minn.
Platt, F. C., Pac. Gas & Elec. Co., San Francisco.
Poole, Chas. O., The Nevada-California Pr. Co., Riverside, Cal.; Palace.
Pitts, H. P., Pac. G. & E. Co., San Francisco, Cal.
Poole, Mrs. Chas. O.; Palace
Powell, R. C., Pac. Gas & Electric Co., San Francisco.
Price, Chas. W., Pres. Electrical Review Pub. Co., Chicago, Ill.
Price, E. B., Pac. Gas & Elec. Co, San Francisco
Pyle, C. G., Standard Underground Cable Co., Los Angeles, Cal.

Quick, George A., Commonwealth Edison Co., Chicago, Ill

Ramstad, A. G., Pacific Gas & Electric Co., San Jose, Cal.
Ransdall, R. A., Sierra & San Francisco Power Co.
Ray, D. C., Pac. Gas & Elec. Co., Martinez, Cal.
Reynolds, L. H., California R. R. Commission, San Francisco.
Rice, H. C., G. M., General Inc. Lamp Div. G. E. Co., Cleveland, Ohio, Herald.
Rice, Mrs. H. C; Herald.
Richards, Jesse, New York & Queens Elec. Lt. & Power Co., Long Island City, New York.
Richardson, A. N., Gen. Supt. Kansas City Elec. Light Co., Kansas City, Mo.; Clift.
Ricketts, F. E., Cons. Gas, Elec. & Pr. Co., Baltimore, Md.; St. Francis.
Ripley, L. O., V. P. & G. M., Kansas G. & E. Co., Wichita, Kans.
Ripley, Mrs. L. O.
Ribbins, Chas, Westinghouse Elec. & Mfg. Co., East Pittsburg, Pa.; Palace.
Robbins, Mrs. Charles; Palace.
Rogers, Edwin A., Pacific Gas & Elec. Co., San Francisco.
Robbins, Walter, V. P., Wagner Elec. Mfg. Co., St. Louis, Mo.
Robbins, Mrs. W. C.
Robertson, C. E., Cons. Gas Electric Lt. & Pr. Co. of Baltimore, Md.; Fairmont.
Robertson, Mrs. C. E.; Fairmont.
Robinson, Walter P., Edison Elec. Illg. Co. of Brooklyn; Clift.
Roemer, John H., Ark. Valley Ry., Lt. & Pr. Co., Pueblo, Colo.; Palace.
Rogers, Mrs. Henry B.; Palace.
Rogers, Miss Margaret; Palace.
Rollins; R. W., Worcester Electric Lt. Co., Worcester, Mass.
Rolph, James Jr., Mayor, City of San Francisco.
Rose, W. J. M., Alliance Gas & Power Co., Alliance, Ohio; St. Francis.
Rose, Mrs. W. J.; St. Francis.
Rosenquest, E. H., Pres. & G. M. Bronx Gas & Elec Co., Westchester, N. Y.; St. Francis.
Rosok, I. A., Bisbee Improvement Co., Bisbee, Ariz.
Russell, R. J., Century Electric Co., St. Louis, Mo.
Russell, Mrs. R. J.
Russell, S. P., Mgr., S. F. Office, H. W. Johns-Manville Co., S. F.
Russell, Mrs. S. P.
Ryan, E. J., Smith Falls Elec. Pr. Co., Smith Falls, Ont.
Ryan, Harris J., Prof. of E. E. Leland Stanford Jr. University.
Ryan, W. D'A., General Electric Co., Schenectady, N. Y.
Ryan, Mrs. W. D'A..
Ryerson, W. N., G. M. Great Northern Power Co., Duluth, Minn.

H. T. Sands, V. P., Malden Elec. Co., Malden, Mass.; St. Francis.
Sanford, F. W., General Elecric Co., Harrison, N. J.
Sanford, Geo. B., Great Western Power Co., Rio Vista, Cal.
Sanford, Mrs. George B.
Sawyer, L. P.
Sawyer, Mrs. L. P.
Scarfe, George, Pac. G. & E. Co., Nevada City.
Schlacks, Chas. F. H., Com. Edison Co., Chicago, Ill.; Bellevue.
Schlacks, Mrs. Chas. F. H.; Bellevue.
Schluederberg, Westinghouse Elec. & Mfg. Co., East Pittsburgh; Clift.
Schmidley, W. R., Wisconsin R. R. Commission, Madison, Wis.
Schmidley, Mrs. W. R.
Schmitt, Frederick, The New York Edison Co., N. Y. City; Clift.
Schmitt, Frederick, The New York Editson Co., N. Y. City; Clift.
Schneider, G. A., Western Electric Co., San Francisco, Cal.

Scholze, William, Kansas City Elec. Lt. Co., Kansas City, Mo.; Clift.
Schroeder, Henry, Edison Lamp Wks., Harrison, N. J.
Schuyler, F. S., Allis-Chalmers Co., Los Angeles, Cal.
Schweitzer, S. E., Sec.-Treas., Omaha Elec. Light & Pr. Co. Omaha, Nebr.; Palace.
Schweitzer, Mrs. S. E.; Palace.
Scott, C. B., Middle West Utilities Co., Chicago, Ill.
Scott, Holton H., Cities Service Co., New York City; St. Francis.
Scrugham, J. G., E. E. Elko Lamoille Piwer Co., Elko, Nev.
Scrugham, Mrs. J. G.
Searing, E. D., Portland Ry. Lt. & Pr. Co., Portland, Ore.; Stewart.
Searing, Mrs. E. D.
Sedgwick, C. E., Pac. Gas. & Elec. Co., Dixon, Cal.
Seiler, H. J., Sierra & San Francisco Pr. Co., San Francisco, Cal.
Sewall S. A., Asst. to Sec. N. E. L. A., N Y. City; St. Francis.
Sewall, Mrs. S. A.; St. Francis.
Shetky, Miss Mary E.; St. Francis.
Sladen, H. S., Asst. G. M. Kansas Gas & Elec. Co., Wichita, Kan.
Sladen, Mrs. H. S.
Slaymaker, George D., Eastern Mich. Ed. Co., Rochester, Mich.; St. Francis.
Small, Deane B., New England T. &. T. Co., Portland, Me.; Fairmont.
Small, F. W., Pac. Gas & Elec. Co., San Francisco, Cal.
Small, W. G., Edison Elec. Illg. Co. of Brockton, Mass.
Smith, Frank E, Weston Electrical Instrument Co., S. F.
Smith, Mrs. Frank E.
Smith, Vinton, Standard Underground Cable So., San Francisco.
Snoeberger, C. D., Pres. Plymouth Elec. Lt. & Pr Co. Plymouth, Indiana; Palace.
Snoeberger, Mrs. C. D.; Palace.
Snyder, Frederick T., Pres. Snyder Elec. Furn. Co., Chicago, Ill. Fairmont.
Snyder, H. L., Sec.-Treas., N. Y. & Queens Elec Lt. & Pr. Co., Long Island City, New York; St. Francis.
Sofisburg, George, Sierra & San Francisco Pr. Co.
Somers. L. A., Westinghouse Elec. & Mfg. Co., San Francisco.
Spencer, Paul, E. E., United Gas Imp. Co., Philadelphia, Pa.; St. Francis.
Spencer, Mrs. Paul.
Sproule, Thomas, Philadelphia Elestric Ci., Philadelphia, Pa.; St. Francis.
Sprunt, J. P., Westinhouse Elec. & Mfg. Co., Denver, Colo.; Clift.
Stafford, Rex. T., Allis-Chalmers Mfg. Co., Seattle, Wash.
Stannard, C. N., Denver Gas & Elec. Lt. Co., Denver, Colo.; Bellevue.
Stannard, Miss Carroll; Bellevue.
Stannard, Miss Evelyn; Bellevue.
Stearns, Walter M., General EElec. Co., Pittsfield, Mass.; Palace.
Stearns, Mrs. Walter M.; Palace.
Steele, E. H., Pacific Gas & Electric Ca., San Francisco.
Steele, H. G., Sec.-Treas., Pittsburg Trans. Co., Pittsburg. Pa.
Stephenson, C. A., Supt. Elko Lamoille Pr. Co., Elko, Nev.
Stephenson, Mrs. C. A.
Stern, Miss Ione
Stern, Percival, Pres. & G. M. Interstate El. Co., New Orleans, La
Stern, Mrs. Percival.
Stevens, Chas. H., Edison El. Illg. Co., Brooklyn, N.Y.; St Francis.
Stilwell, Dr. B. W., V. P., Westchester Lighting Co., Mt. Vernon, New York.; Fairmont.
Stilwell, Mrs. B. W.; Fairmont
Stoddard, C W., Tabulating Machine Co., San Francisco, Cal.
Stoddard, Mrs. C. W.
Stone, C. W., General Electric Co., Schenectady, N. Y.
Story, Byron T, So. Cal. Edison Co., Los Angeles; Clift.
Strasser, J. M., Public Service Co. of No. Ill., Chicago, Ill.
Strasser, Mrs. J. M.
Strong, E. B., Journal of Electricity, Power and Gas, S. F.
Symes, R. W., Gen. Acct, Peninsular Elec. Lt. Co., Dethroit, Mich.; St. Francis.
Symes, Mrs. R. W.; St. Francis.
Theis, A. J., Pacific Gas & Electric Co., San Francisco, Cal.
Thompson, A. V., Pacific Gas & Electric Co., San Francisco.
Thompson, A. R., Pacific Gas & Electric Co., San Francisc.
Thompson, Miss Hazel
Thompson, Jos. S., Pacific Elec. Mfg. Co., San Francisco, Cal.
Thompson, W. B., Peninsular Elec. Lt. Co., Detroit, Mich.
Thompson, Mrs. W. B.
Thompson, William, Pacific Gas & Elec. Co., San Francisco.
Thornton, M. E., Pres. Wr. Pr. Elec. Co., Hickory, N. C.
Tobey, J. C., Pacific Gas & Elec. Co., Sacramento, Cal.
Todd, Willis, G. M., Columbus Lt., Ht. & Pr. Co., Columbus, Neb.
Tobey, I. O., Pacific Gas & Elec. Co., Sacramento, Cal.
Tonkin, W. J., Asst. Sec. the Ansonia Elec. Co., Ansonia, Conn.; St. Francis.
Torchio, Philip, Chief. Elec. Engr., The N. Y. Edison Co., N. Y. City; St. Francis.
Torzillo, George M. Sangamo Elec. Co., Springfield, Ill., Palace of Machinery.
Torzillo, Mrs. George M.
Trowbridge, A. L., Pac. Gas & Elec. Co., San Francisco.
Traver, Alva F., The Denver Gas & Elec. Lt. Co., Denver, Colo.; Bellevue.
Traver, Mrs. Alva F.
Turner, M. E., Cleveland Elec. Illg. Co., Cleveland, Ohio.
Turpin, M. C., Westinghouse El. & Mfg. Co., East Pittsburgh, Pa.

Underhill, J. Delmar, The Okonite Co., N. Y. City; Clift Hotel.

Vahey, J A., Edison Elec. Illg. Co. of Boston, Mass; St. Francis. St Francis.
Van Bergen, Curtis E., Sec. and G. M. Duluth Edison Elec. Co., Duluth, Minn.
Van Hooser, John S., Pac. Gas & Elec. Co., San Francisco.
Van Kuran, K. E., Westinghouse Elec. & Mfg. Co., Los Angeles.
Van Kuran, Mrs. K. E.
Van Loben, Sels, Pac. Gas & Elec. Co., Oakland.
Van Riper, H. T., Hotpoint Electric Htg. Co., Seattle, Wash.
Varney, F. H., Pac. Gas & Elec. Co., San Francisco.
Varney, J. W., Pac. Gas & Elec. Co., San Francisco.
Vieson, Frederick C., Peninsular Ele. Light Co., Detroit, Mich.; St. Francis.
Vieson, Mrs. Frederick; St. Francis.
Vincent, W. G. Jr., Pac. Gas & Elec. Co., San Francisco.
Vragnisan, D. C., Pac. Gas & Elec. Co., San Francisco.

Wagner, Herbert A., Pres., Cons. Gas, Elec. Lt. & Pr. Co. of Baltimore; Fairmont.
Wagner, Mrs. Herbert A. Wagner; Fairmont.
Wagner, Mrs. Herbert A; Fairmont
Wakeman, James, G. M., Society for Elec. Dev., New York City; Clift.
Wakeman, Mrs. James M.; Clift.
Wales, M. F., Sierra & San Francisco Power Co.
Wallace, L. M., Edison Elec. Illg. Co. of Boston, Mass.
Walton, John N. Commonwealth Edison Co., Chicago, Ill;
Walton, S. V., Mgr., Commercial Dept., P. G. & E. Co., S. F.
Wardell, Fred, Pres. Eureka Vacuum Cleaner Co., Detroit, Mich.
Warford, H. S., Public Service Elec. Co., Camden, N. J.
Warford, Mrs. H. S
Watson, R C., The New York Edison Co., N. Y. City; Clift.
Watts, Sewell S., Baker, Watts & Co., Baltimore, Md.; Fairmont.
Watts, Mrs. Sewell S.; Fairmont.
Weaver, C. I., Gen. Sales Mgr., Hodenpyl Hardy & Co., Jackson, Mich.; Clift.
Webster, E. H., Queens Borough Gas & Elec. Co., Far Rockaway, New York; Clift.
Webster, F. L., Allis-Chalmers Mfg. Co., San Francisco.
Wellman, Geo. H., Electrical Review & Western Electrician, Chicago, Ill.
Wernicke, Carl L., Westinghouse El. & Mfg. Co., Portland, Ore;. Clift.
Wernicke, Mrs. Carl L.; Clift.
Werry, John, Pac. Gas & Elec. Co., Nevada City, Cal. Bellevue.
West, Arthur B., The Southern Sierras Power Co., Riverside, Cal.
West, Mrs. Arthur B.; Palace.
West, John, Mgr. New Business, Chas. H. Tenney Co., Boston, Mass.; St. Francis.
West, Mrs. John; St. Francis.
West, Mrs. D. P.; St. Francis.
Weymouth, E. A., Pac. Gas & Elec. Co., Sacramento, Cal.
Whaley, Edward, Northern Cal. Power Co., San Francisco.
Wheeler, H. F., Gen. Mgr, Hattiesburg Trac. Co., Hattiesburg, Miss.; St. Francis.
White, F. L., Prop. Traer Electric Co., Traer, Iowa.
Whitton. W. H., Gen. Agt., The N. Y. Edison Co., N. Y. City; St. Francis.
Wickham, J. F., Treas., Union Gas & Elec. Co., Cincinnati, O.; Ualace.
Wickham, J. F.; Palace.
Wilde, Ferdinand A. Jr. Treas.-Mgr., Desert Pr. & Wtr. Co., man, Ariz.
Wilde, J. R., Peninsular Elec. Lt. Co., Detroit, Mich.; St. Francis.
Wilde, Mrs. J. R.; St. Francis.
Williams, Arthur, General Inspector, The New York Edison Co., New York City; St. Francis.
Williams, George, Cities Service Co., N. Y. City.
Wilson, C. J., Pac. Gas & Elec. Co., San Francisco.
Wilson, F. W., Standard Underground Cable Co., San Francisco.
Wilson, H. M., Edison Storage Battery Co., Orange, N. J.; Block No. 12, Transportation Bldg., Exposition.
Wilson, Hugh M., V. P. Electrical World, N. Y. City; St. Francis.
Wilson, Mrs. Hugh M., St. Francis.
Wolcott, F. E., Franklin Elec. Mfg. Co., Hartford, Conn.; Palace.
Wolcott, Mrs. F. E.; Palace.
Wolff, Samuel E., Hodenpyl, Hardy & Co., Inc., N. Y. City, St. Francis.
Wright, Mrs. M. D.; Fairmont.
Woodward, F. H., Great Western Power Co., Oakland, Cal.
Wylie, J. W., V. P., West Sacramento Elec. Co., Sacramento, Cal.

Young, A. W., Public Service Electric Co., Camden, N. J.
Young, Mrs. A. W.
Young, C. E., Pac. Gas & Elec. Co., San Francisco.
Young, Richard R., Public Service Electric Co., Newark, N. J.; Fairmont.
Young, Mrs. R. R.; Fairmont.

Zimman, J. B., Contract Agt., Omaha Electric Lt. & Pr. Co., Omaha, Neb.

MEETING NOTICES.

Alameda County Electrical Development League.

A well attended luncheon of the league was held May 29th in the Oakland Municipal Auditorium, B. C. Hill presiding and Romaine W. Myers acting as chairman of the day. Every article of the elaborate menu was cooked electrically, special electric ranges having been installed for the purpose. H. H. Cudmore spoke of the growth of the Jovian Order and the benefits to be derived from membership therein. J. J. Donovan, city architect, talked of "The Relation Between the Architect and the Electrical Engineer," advocating that owners should employ electrical engineers directly. C. C. Davis of the General Electric Company dwelt upon the material advantages of wiring with base board receptacles and separate meter for electric cooking circuits. Mr. Martinez of the Western Electric Company explained the advantages and economy of electric cooking. At the conclusion of the lunch Mr. Myers guided the guests on a tour of inspection through the auditorium.

The Jovian Electrical League of Southern California.

The weekly luncheon of the League on May 26th was attended by over 100 Jovians and their friends and was presided over by Chief Stentor A. E. Morphy, in the absence of Tribune Harry Pieper. After the customary introduction of guests and the imposition of fines, a number of announcements were made regarding the coming N. E. L. A. trips and visits and an electrical parade committee was appointed, consisting of Messrs. Harrison, Thomas and Shannon. Announcement was made of the loss sustained ot National Congressman J. G. Pomeroy, in the death of his wife, and Messrs. Colkitt, Case and Damon were appointed a committee to prepare resolutions of sympathy. The league went on record of favoring the two platoon system for the fire department. W. L. Graves Jr. acted as chairman of the day ond introduced Miss Lillian Vierriman, who entertained those present with several songs, accompanied by Dick Alter. A splendid, inspiring address on "California" was then delivered by Capt. John D. Fredericks, recent gubernatorial candidate.

Electrical Development and Jovian League.

At the weekly lunch on May 26th, 140 members were in attendance to enjoy the excellent program which had been provided by W. L. Goodwin as chairman of the day. After the routine business had been transacted President Leggett turned over the meeting to Mr. Goodwin who had provided a musical novelty in a band of Hawaiian singers. Afterwards he introduced Dr. Thomas Addison, Pacific Coast manager of the General Electric Company, who gave an able talk on "Business." He explained the importance of the modern corporation in our industrial development and gave a strong tribute to the corporation with a soul,—a corporation animated by the ideals and spirit of the men at its head. In the course of his remarks Dr. Addison took occasion to refute several popular fallacies, including the error that low prices are beneficial, the adverse influence of the administration in power and "competition is the life of trade. As an example of the benefits of co-operation he cited the effect of the Federal reserve bank in obviating bank hoarding. He also spoke of the tremendous advance in welfare work and of the prosperous future in store for this country. Before adjournment Mr. Goodwin and Dr. Addison were given a hearty vote of thanks.

Portland Jovian League.

The regular weekly luncheon was held May 28th in the dining room of the Benson Hotel, with an attendance of 100. The entertainment was furnished by the Pacific Power & Light Company, J. E. Davidson, vice-president and general manager, being chairman of the day. The various committees that have charge of the Jovian Float, Vehicle and Band Parade, and Stunts for the Rose Carnival, all reported good progress. The following committees were appointed: Membership, A. C. McMicken, chairman; Entertainment, A. S. Moody, chairman; Luncheon, Robert Skeen, chairman; Ways and Means, F. O. Broill, chairman.

In the contest for an illuminating answer to "Mazda Means Something! Watt?" Miles Standish won first prize an electric chafing dish, with an answer "Means a lighter shock on the first of the month"; Geo. A. Knowles won second prize, an electric percolator, with "Three meals a day to me," and A. S. Moody, the booby prize, two burned out lamps, with an answer which did not pass the censor.

Mr. W. N. Catlan was the speaker of the day. His talk was along the general subject of success. He pointed out three fundamental requirements. First, Subjection of a person to circumstances; second, A manifestation of energy and love for the work in hand; third, A cheerful, honest and heartfelt wish for the success of the other fellow. Attendance 100.

Electrical Contractors' Jobbers' Meeting.

The monthly meeting of the California Electrical Contractors and dealers was held May 15th in the banquet room of the Hof Brau Cafe, L. R. Boynton, who had been given charge of this meeting, in the chair. About seventy-five jobbers, contractors, jobbers-salesmen and the central station representatives were seated around the table.

N. M. Hope of the Turner Company, was then introduced and read the paper on "Co-operation." President C. V. Schneider announced that the association appreciated the assistance given by the jobbers and their salesmen.

Mr. Boynton then announced that a question had been raised in reference to the advisability of contractors carrying stocks, and a debate had been arranged for. Mr. H. Kimball taking the affirmative, and Mr. Frank W. Watts taking the negative side. Mr. Kimball spoke earnestly and advanced many good reasons why a contractor should carry a stock, and Mr. Watts, on the other hand advanced many good reasons why a contractor should not carry a stock. Mr. W. L. Goodwin in his address later in the evening touched on this subject, and what he said could be summed up as a decision that would show that both sides had merit. Mr. Goodwin stated that a contractor should carry a stock, but that same should be well selected and in proportion to the amount of capital a man had in his business, and same should be built up to meet his requirements as his business grew; he also stated that if this plan was followed that an electrical contractor would mean something.

Mr. Boynton took occasion to analyze the papers that had been selected for Mr. Hillis and Mr. Wiggins, who had been unable to attend the meeting. Dr. Boynton stated that he thought there were too many contractors in the field at the present time, and that he thought a great deal of work could be done by the contractors reaching out into country district and assisting the power companies in developing the business by installing pumping plants, etc.

The next speaker was Secretary W. S. Hanbridge who thanked the salesmen for the assistance given in building up the association and gave a brief report from Vice-President Claude Loveday, of Santa Barbara, on the Southern California situation; and also read an address by Mr. H. B. Crouse, President of the Crouse-Hinds Company, on Policy. Mr. Crouse gave his address before the Manufacturers and Jobbers of Electrical Supplies, at Chicago, March 18, 1915. The paper was full of good points and showed the difficulties that had to be overcome in order to carry out a policy, and find out its good points.

Mr. Boynton stated that he thought the secretary could be of considerable assistance to the jobbers in establishing the credit of the electrical contractors, as many of the failtures in the electrical business has been with firms who, up to a short time previous to their failure, were considered good credit risks. For fifty minutes he explained what could be accomplished by building up the association, and the benefits to be derived by being a member.

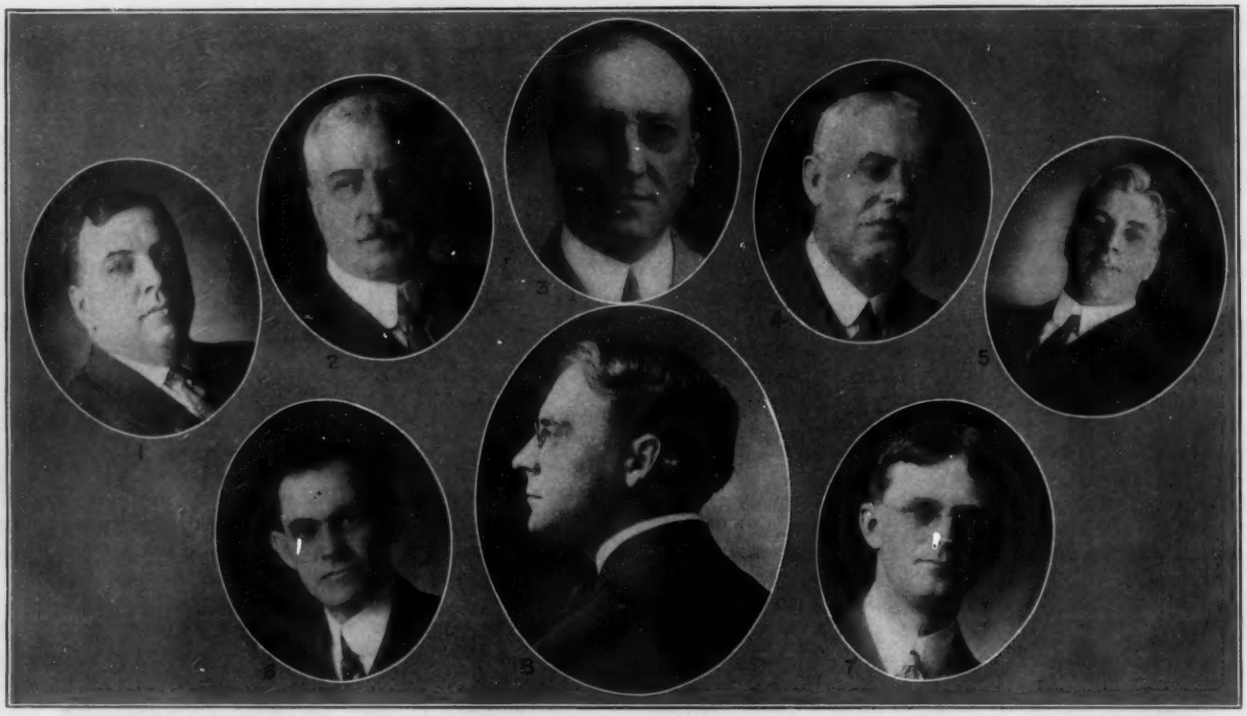
Mr. Boynton then announced that the next monthly meeting of the Contractors-Jobbers would be held in the Forum Cafe, Oakland, Friday evening, June 18, 1915, at 6:15 p. m.

NEW CATALOGUES.

The General Electric Company has recently issued Bulletin No. 41013, giving a detailed description of that company's direct current Commutating Pole Motors, known as Type RC. Illustrations of the various parts of the motors, together with dimension diagrams, are included in the publication. Bulletin No. 48303 is devoted to Hand-Operated Starting Rheostats and Panels for Direct Current Motors. Bulletin No. 44406 describes Ventilated Commutating-Pole Railway Motor, known as GE-247.

P. P. I. E. DIVISION OF EXPLOITATION.

The Division of Exploitation of the Panama-Pacific International Exposition has been in operation three years. It distributes news and information to the press in eighteen languages, issues books and pamphlets, special editions, documentary matter in the principal languages and acts as an agency in broadening the message of the Exposition by carrying throughout the globe the news of the world's progress as exemplified at the Exposition. In public interest the Exposition occupies a place second only to the European war. Several thousand columns of newspaper articles are published each day in the United States alone as a result of the division's activity. It embraces the following bureaus: Newspaper tours, press bureau, news and editorial bureau, bureau of publications, bureau of printing, art bureau, local news bureau, information bureau, bureau of foreign translations.



Department of Exploitation, Panama-Pacific International Exposition. (1) W. Chandler, chief clerk; (2) Thomas D. Parker, secretary press bureau; (3) A. H. Dutton, superintendent writers' section; (4) F. C. Mills, manager bureau of information; (5) Nolan Davis, manager bureau of publications; (6) E. N. Clark, manager art department; (7) Hamilton Wright, editor; (8) George Hough Perry, chief of department of exploitation.

The chief of the division is George Hough Perry, an able and experienced advertising man of national reputation. The result of his effort has been a degree of publicity never before approached by any exposition, all without the expenditure of a single dollar in the purchase of space. His experience with the Wannamaker and Gimbel Bros. department stores taught him that it was not sufficient merely to inform the public. Using the exposition publicity as a foundation, he has carried out elaborate plans for direct selling, turning what might otherwise be merely a vague general interest into the actual determination to take the trip. Furthermore, he believes in taking care of his customers after he has sold them his goods, and his arrangements in San Francisco for the protection, convenience and comfort of travelers are new in exposition practice.

The secretary of the press bureau is Thomas D. Parker, a newspaper man of wide experience in varied capacities, for many years with the Boston Herald, New York Times, New York Herald, San Francisco Chronicle and Examiner, Portland Oregonian, Denver Post and the Colorado Promotion and Publicity Committee. Since 1912 he has been active in his present position with the exposition.

Hamilton M. Wright has charge of the newspaper and magazine publicity emanating from the exposition for use outside of San Francisco. For several years before being associated with the exposition he conducted a syndicate bureau with headquarters in San Francisco, sending telegraphic news and correspondence throughout the United States and England, Canada and Australia. Was selected by a joint bureau of the California newspapers and the Associated Press to expedite the collection of state and national election returns during presidential elections. Has contributed to leading magazines and practically all the leading newspapers in the United States and many abroad.

Nolan Davis, chief of the bureau of publication, is Mr. Perry's right-hand man. In the publication and distribution of over ten million pieces of literature, Mr. Davis has met and successfully combatted the biggest problem of its kind ever presented. When Mr. Davis took office with the exposition his long newspaper-making, printing, engraving and advertising experience thoroughly fitted him for the task before him. After two years' service he has succeeded in covering the earth with the knowledge of the Exposition, San Francisco and California by means of natural color reproductions and high-class booklets. He has supplied over five hundred lecturers with slides of exposition subjects accompanied by interesting lectures, and has incidentally managed the art, mimeograph and multigraph and printing and engraving sections of the exposition.

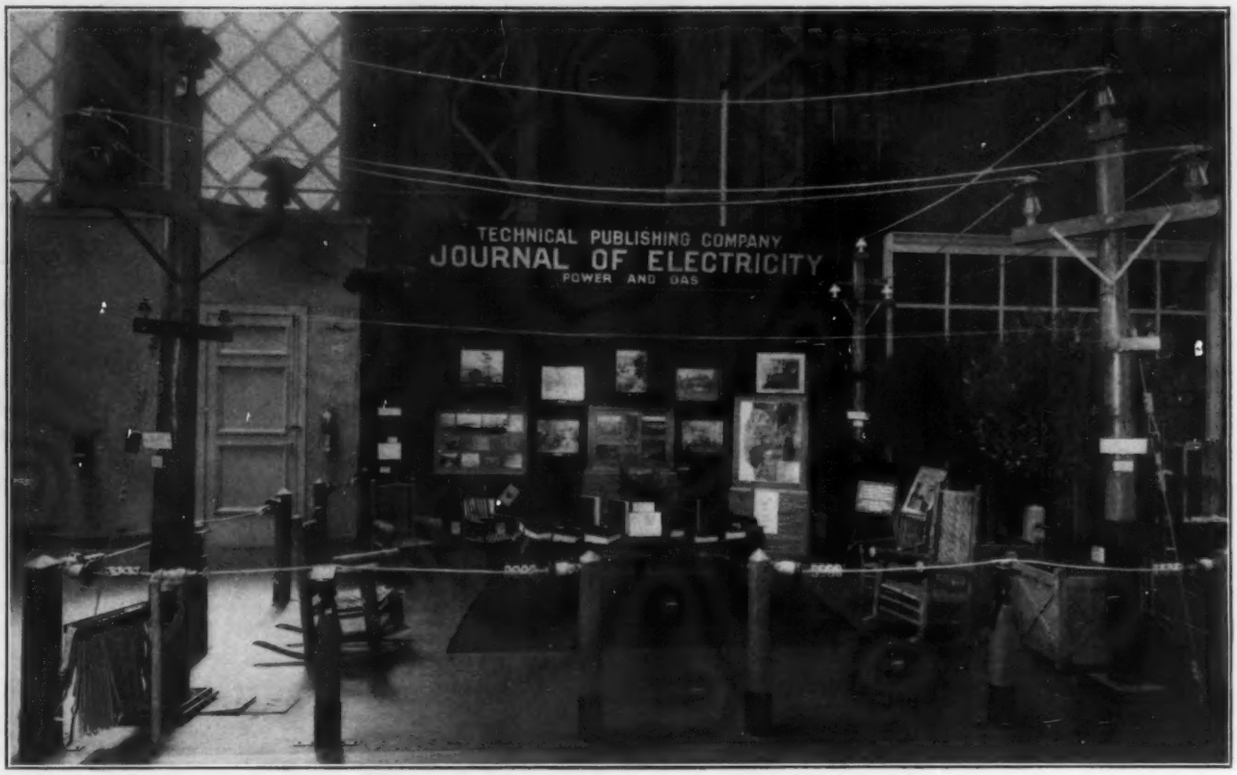
The chief clerk of the department, and the man responsible for much of the organization's smooth running, is W. Chandler. A. H. Dutton is superintendent of the writers' section, his duties giving him direct supervision over a large corps of writers, who have described many special features and exhibits for publication. F. C. Mills is manager of the bureau of information, and E. N. Clark manager of the art department.

PARTIAL LIST OF EXHIBITS PARTICULARLY INTERESTING TO VISITING DELEGATES OF THE N. E. L. A.

Space prohibits the mentioning of all the interesting exhibits; the following have been selected as being representative:

Machinery Palace.

American Well Works—Pumps.
American Bridge Company—Steel tower and poles.
American Steel & Wire Company—Wire and cables.
Aluminum Company of America—Aluminum wire, cable and fittings.
Max Ames Machine Company—Canmaking machinery.
Babcock & Wilcox Company—Various types of water tube steam boilers.
Busch-Sulzer Bros.-Diesel Engine Company—Internal combustion engine.
Krogh Manufacturing Company—Motor driven centrifugal pumps.
The Locke Insulator Manufacturing Company—Insulators, pins and fittings.
Layne & Bowler Corporation—Pumps.
Luitweiler Pumping Engine Company—Pumps.
McIntosh & Seymour Corporation—Oil engine.
McGraw Publishing Company—Engineering publications.
Moloney Electric Company—Transformers.
Millar-Searles—Portable elevators.
Meese & Gottfried Company—Conveying and elevating machinery.
National Brake & Electric Company—Motor driven air compressors.
Neulands Electric Company—High frequency generators.
Otis Elevator Company—Elevators.
Pacific Electric Manufacturing Company—High voltage oil and air break switches.
The Pelton Water Wheel Company—Tangential and turbine water wheels, pumps, water wheel governors, needle nozzles, etc.
Robbins & Myers—Small motors and fans.
Standard Underground Cable Company—Copper wires and cables, junction boxes, open air and station terminals, operating machines for applying braided insulation and coverings on wires and cables.
Standard Oil Company—Demonstrating the uses of lubricating oils.
Sangamo Electric Company—Meters.
San Francisco Examiner—Hoe printing press in operation.
Simonds Machinery Company—Pumping plants.
Thordarson Electric Company—Transformers.
R. Thomas & Sons Company—High tension porcelain insulators.
United States Government—War Department exhibit.
Union Oil Company of California—Reproduction of the oil fields, showing methods of transportation, producing, refining and distribution of petroleum oils and by-products.



Historical Exhibit of Journal of Electricity, Power & Gas, in Connection With Pierson, Roeding & Co., and Wagner Electric Manufacturing Company.

Bristol Company—Recording instruments.
Bessemer Gas Engine Company—Gas and oil engines.
Bowie Switch Company—High tension switches and circuit breakers.
Byron Jackson Iron Works—Pumps.
E. W. Bliss & Co.—Sheet metal machinery.
Berger & Carter Company—Sheet metal machinery.
Baruch Electric Controller Corporation—Thermo-relay.
Century Electric Company—Motors.
Edison Storage Battery Supply Company—Storage batteries, alternating current rectifiers, etc.
The Electric Storage Battery Company—Exide starting and lighting batteries.
G. M. Gest—Electric conduit system.
Hydraulic Press Manufacturing Company—Power pumps and valves.
Harron, Rickard & McCone—Water-handling appliances, internal combustion engines, pumps, etc.
Journal of Electricity, Power & Gas—Back numbers since 1895 and illustrations of the development of hydroelectric transmission in the West.

United States Seel Corporation—Transmission line material.

Western Transformer Company—Transformers of various types.

Westinghouse Airbrake Company—Motor driven air compressors.

Westinghouse Lamp Company—Mazda lamps.

Westinghouse Machine Company—Steam turbines, condensers, reduction gears, pumps.

Westinghouse Electric & Manufacturing Company—Various types of alternating and direct current motors, controllers, automatic electric ranges, electric heating devices, fans, turbo generators, etc.

Mines and Metallurgy Palace.

American Bridge Company—Steel transmission tower and poles.

Baldwin Locomotive Works—Electric mine locomotives in Government mine exhibit.

W. P. Fuller & Co.—Operating exhibit, manufacturing white lead.

The Locke Insulator Manufacturing Company—Suspension insulators, clamps and fittings.

Standard Oil Company—Exhibit in miniature of the petroleum industry.

Union Oil Company of California—Exhibt showng petroleum products.

U. S. Steel Corporation and subsidiary companies—Illustrating entire range of operations from time the iron ore is taken out of the ground until issued from the mills as finished products.

United States Government—"The Mine."

U. S. Bureau of Mines—Exhibit showing various methods of mining, with machinery and equipment.

Western Electric Company—Mine telephones and mine rescue telephone apparatus; situated in "The Mine."

Westinghouse Electric & Manufacturing Company—Electric mining and industrial locomotives, also motors driving air compressors, blowers, pumps, etc., located in "the Mine."

United States Government—U. S. mint exhibit.

United States Government—U. S. postoffice exhibit.

Transportation Palace.

American Ever Ready Works of National Carbon Company—Dry cells, batteries, carbons, and carbon brushes, storage batteries, lamps, sockets and other electrical supplies and details.

Edison Storage Battery Supply Company—Storage batteries of all types.

General Electric Company—Railway motors, railway motor control, electric locomotives, switching apparatus, battery truck crane, overhead line material, electric welding outfit.

Union Metal Manufacturing Company—Electrolier street posts.

Westinghouse Electric & Manufacturing Company—Pennsylvania electric locomotive on turntable, railway motors, railway motor control, operating exhibit, high voltage circuit breakers and switches, switchboards with instruments and equipment, battery charging panels and automobile equipments.

Ford Motor Company—Assembling Ford automobiles.

Pennsylvania Railroad Company—Models of terminals and relief maps.

Southern Pacific Company—Earliest and latest types of locomotives, etc.

Western Pacific and Denver & Rio Grande Railroad—Showing panorama of territory covered.

American Locomotive Company—Modern steam locomotives.

Baldwin Locomotive Works—Modern steam locomotives.

Agriculture Palace.

International Harvester Company—Motor driven agricultural machinery.

Food Products Palace.

Sperry Flour Company—Miniature flour mill in operation, samples of product cooked on Hughes electric ranges.

United States Government—Fisheries exhibit.

Educational Palace.

United States Government Exhibit.

Japanese Government Exhibit.

Liberal Arts Palace.

American Telephone & Telegraph Company—Talking to New York and the East.

United States Government—Bureau of Standards and other exhibits.

Western Union Telegraph Company—Mechanical transmission of telegrams.

Dover Manufacturing Company—Automatic electric irons.

Good Housekeeping, Electric Cooker Company—Electric cooker.

Manufactures Palace.

General Electric Company—"Home Electrical," household devices, illumination of the home, Mazda lamps, arc lamps and research laboratory exhibit.

Majestic Electric Development Company—Electric hot water faucet.

Pacific Gas & Electric Company—1000 kw. motor generator set.

Presto Electric Company—Electric heating appliances.

Western Electric Company—Telephone apparatus, wiring devices, current consuming devices and electrical supplies.

Japanese Government Exhibit—Interesting exhibit of ceramics, silk products, etc.

Italian Government Exhibit—Magnificent display of marble statuary.

Collective Gas Exhibit.

Horticulture Palace.

Anderson-Barngrover Manufacturing Company—Motor driven farm implements and fruit handling machinery.

PUBLICATIONS RECEIVED.

"The Effect of Boron Upon the Magnetic and Other Properties of Electrolytic Iron Melted in Vacuo," by Trygve D. Yensen, has just been issued as Bulletin No. 77 of the Engineering Experiment Station of the University of Illinois.

Westinghouse Lamp Company has issued the first handbook in their educational campaign for electrical salesmen, this campaign to consist of a series of monthly bulletins devoted to the application and development of lamps and principles of illuminating engineering. This entire series will be sent without charge upon request.

BOOKS RECEIVED.

"Modern Illuminants and Illuminating Engineering." By Leon Caster and J. S. Dow; 464 pp.; 6x9 in. Published by The Macmillan Co., New York, and for sale by Technical Book Shop, San Francisco. Price $5.00.

From time to time it seems necessary to make a resume of what has already been accomplished in any given field as a guide to new students or practitioners in that field. To such a class of readers this exhaustive compilation of all the branches of the lighting industry should be of interest. The first four chapters are purely historical, particularly as regards oil, gas and electric lighting. The next two deal with the eye in its relation to illumination and to color. Chapter

VII deals with the measurement of light, Chapter VIII with reflectors, Chapter IX with interior lighting problems and Chapter X with outdoor lighting. It brings within the limits of one volume a mass of information from many sources. To the lighting specialist it contains little that is new, for library or general use it is a good book for reference.

"Electricity for the Farm." By F. I. Anderson; 265 pp.; 5x7½ in. Published by the Macmillan Company, New York City and for sale by Technical Book Shop, San Francisco. Price, $1.25.

The best way to popularize the use of electricity is to remove the mystery which the average layman associates with it and to explain the convenience and safety of electrical devices. This purpose is admirably accomplished by this book. While it is written primarily for the instruction of the farmer who has waste waterpower on his place, it is also well adapted for the man who can tap the distributing lines of a nearby electric power company. The volume gives a practical working knowledge of the use of electricity for light, heat and power,and tells the farm mechanic how to install his own plant. The installation of water wheels is described in detail as are also the principles of the direct current dynamo and apparatus for utilizing the current. The style is non-technical and easily understood by the average farmer.

"Electric Railway Handbook." By Albert S. Richey, assisted by Wm. C. Greenough; 832 pp.; 4 by 6½ in.; thin paper; leather bound. Published by McGraw-Hill Book Company, New York, and for sale by Technical Book Shop, San Francisco. Price $4.00.

The engineering handbook is an institution. Beginning as a broad treatise covering every branch of engineering each year has witnessed greater specialization in text to correspond with corresponding specialization in practice. This, the latest addition to the family, is a healthy and attractive specimen, well written, logically arranged and well printed and bound. The text is sub-divided into eleven sections treating respectively of roadbed and track, buildings, train movement, railway motors, controlling apparatus, current collecting devices, tracks, braking, rolling stock, transmission and distribution, and signals and communication. The treatment includes most of the essential data, formulas and tables used in practice and omits many non-essentials often found in such texts. It is adapted to the use of the non-technical manager or operator as well as the engineer and is in every way fitted to be in the side pocket of every progressive electric railway man.

"Public Utilities; Their Present Value and Return." By Hammond V. Hayes; 207 pp.; 6x9 in. Published by D. Van Nostrand Co., New York, and for sale by Technical Book Shop, San Francisco. Price $2.00.

Interpreters, people who can make other people understand things, are always in demand. This function is admirably filled by the author of this latest contribution to a literature that has threatened to become so complex and so contradictory as to defeat its own purpose—that of telling how to evaluate public utilities for rate making purposes. By a broad and tolerant recognition of divergent opinions and a keen analysis of the good and bad features of each, Mr. Hayes, who has already written a standard text on methods of appraisal, shows how these several viewpoints should be combined in ascertaining a fair charge for service. Much of his argument is based upon the equation: "Fair present value × fair rate of return = (fair charges for service × units of service consumed) — operating costs." Each element of this equation is discussed in detail, with complete and precise definition of such mooted subjects as replacement cost, actual original cost, going value and depreciation. The last named is discussed in great detail as regards the sinking fund method, the straight line method and the equal annual payments method, his conclusion being that the second "can be employed for most cases with the certainty that by its use the required justice will be accorded both to the users and to the company." This book is indispensible to anyone desiring to be well informed on the subject.

"Dielectric Phenomena in High Voltage Engineering." By F. W. Peek Jr.; 265 pp.; 6x9; 190 illustrations. Published by McGraw-Hill Book Co., New York City and for sale by Technical Book Shop, San Francisco. Price $3.00.

Heretofore the design of insulation has been largely a matter of cut-and-try. But high voltages require more accurate pre-determinations. This is possible by a study of di-electric field phenomena, a study which until recently has been obscured by mathematical complexities. In this text this complexity is cleared by using the simple analogy between the di-electric and electric circuit and employing the conception of an electrical "elastance" as the reciprocal of the permittance of a substance. This greatly simplifies the calculation. The author refrains from employing the darof (the reciprocal of the farad, just as the mho is the reciprocal of the ohm), and thus does not attain the full degree of simplicity which its use makes possible. But in every other respect the treatment reflects the latest research on the subject. Much of the text is concerned with a discussion of corona and how it may be obviated by the use of liquid and solid insulations. The treatment is essentially mathematical and in accordance with the dictates of the electron theory, which is reviewed and applied in detail. Complete experimental evidence is presented regarding all theoretical deductions, and in the concluding chapters practical examples of corona calculations for transmission lines and the practical design of apparatus to withstand corona and spark-over are fully discussed. To every engineer interested in the efficient operation of high voltage lines at high altitudes or in fog, smoke, rain, sleet or snow the suggestions in this volume should be most valuable.

"Engineering Economics." By J. C. L. Fish; 217 pp.; 6x9; Published by McGray-Hill Book Company, New York City. For sale by Technical Book Shop, San Francisco. Price $2.00.

Engineering design has progressed to such a stage that there is seldom any question as to the possibility of devising a structure to meet any given condition, except as to its cost. Cost determines feasibility; not first cost, but ultimate cost. And so the activity of the modern engineer is limited by economical considerations. Though Prof. Fish, whom most Pacific Coast engineers on account of his excellent courses of instruction at Stanford University, has seen fit to entitle his book "Engineering Economics," the text is concerned primarily with the problem of economic selection, choice based solely on long run least cost." Before explaining the methods for solving this problem the author first defines its several elements, interest, sinking fund, annuities, first cost, salvage value, depreciation, amortization, maintenance, and cost estimation. The mathematical formulas are derived in each case and complete tables of data presented. With these various elements in mind the author discusses the solution of the problem of economic selection in accordance with some one of the four bases of comparison—(a) yearly cost of service, (b) capitalized cost of service, (c) cost per unit of service, (d) capitalized cost per unit of service per year. The procedure to be followed is described in detail and illustrated by fifteen specific examples of economic selection and comparison. These examples include such problems as the economic size of pipe lines, tunnel versus ditch and flume. Diesel versus non-condensing engine. A complete bibliography gives wide reference to more advanced problems. While written from an engineering standpoint, this book contains information of practical value to executives and managers upon whose judgment depends the choice, design, construction or operation of engineering structures as well as to anyone concerned with the evaluation of public utilities.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The commission has issued a supplemental order in the matter of the application of the Pacific Gas & Electric Company for authority to issue 19,226 shares of its common capital stock. The commission's original order provided that the company should make certain adjustments as to depreciation accounts, and also that it should present in writing to the commission an agreement to the effect that the authorizaation of this stock should not be used as a basis for the determination of rates to be charged by the company. The company has now complied with the above conditions and they are approved in the supplemental order.

The commission has issued its findings upon the value of the properties of San Francisco-Oakland Terminal Railways. These properties consist of the Oakland Traction Company, owning the street railway system in Oakland, and the so-called "Key Route System," owning the interurban railway and ferry system between San Francisco, Oakland and Berkeley. The valuation of the commission included also the property of the Oakland Terminal Company, which is a large land owning corporation, owned by the San Francisco-Oakland Terminal Railways. The commission finds the reproduction cost of all of these properties, with all allowance, to be the sum of $26,912,865. The commission finds further that the reproduction cost less depreciation amounts to $23,641,893. These allowances include land multiples, et cetera, amounting to approximately $900.000. The commission finds that the net indebtedness of the railways and the Oakland Terminal Company, including all outstanding bonds, notes, et cetera, amounts to approximately $21,000,000.

The commission has issued an order authorizing the Fresno Interurban Railway Company to issue 250 shares of its capital stock of the par value of $100 per share, and $70,000 of its first mortgage bonds. The order provides that the company may sell its stock at not less than $80 per share and its bonds at not less than 90 per cent of their face value.

The commission has issued an order granting the River Bend Gas & Water Company a certificate of public convenience and necessity to operate a gas distributing system in the city of Reedley and other portions of Fresno county.

INTERNATIONAL ENGINEERING CONGRESS.

The Materials of Engineering Construction will receive special attention in the proceedings and discussions of the International Engineering Congress to be held in San Francisco, September 20-25 next. The field will be treated under 18 or more topics, covering: Timber resources; preservative methods; brick and clay products in general; life of concrete structures; aggregates for concrete; water proofing; volume changes in concrete; world's supply of iron; life of iron and steel structures; special steels, status of copper and world's supply; alloys; aluminum; testing of metals, of full sized members, and of structures.

Some 25 papers are expected for this volume, prepared by authors representing five different countries. The list of authors includes many of the most eminent names in this field of engineering work throughout the world.

These papers, together with discussions contributed by leading American and foreign engineers, will be published as volume 5 of the transactions, and will be illustrated with charts, diagrams and half tones. The volume will form a most valuable acquisition to the library of all engineers and others who may be interested in these phases of engineering work.

TRADE NOTES.

The Baicourt Electric Company of Portland have just completed wiring the new brick building built by Earl Fisher in Beaverton, Oregon.

The contract for the electric wiring of the new Juvenile Detention Home, Seattle, Wash., has been award to the Rainier Electric Company, Seattle.

The contract for the electrical wiring and fixtures for the new Mohawk building, Spokane, Wash., has been awarded to the Doer Mitchell Electric Company at $2500.

The West Coast Engineering Company has obtained the electrical contract for the rewiring of the Hughes Estate Building at the corner of Fourth and Onkney streets. Portland.

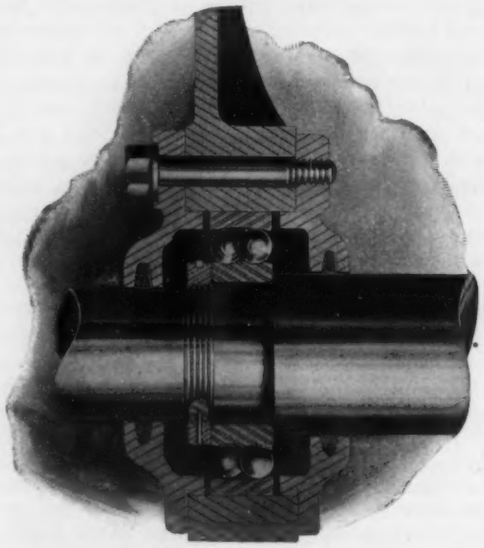
The Smith, McCoy Electric Company has installed the electrical equipment of the East Side Boiler Works new plant located at East Water and Main streets, Portland, Oregon.

R. R. Poppleton of Portland, Oregon, installed a small lighting plant in the Columbia River Packers' Association salmon cannery at Roast Rock, Oregon. The generator is driven with a small Pelton water wheel.

ELECTRIC MOTORS WITH BALL BEARINGS.

Efficiency in all things is the cry of the period. In other words, get the most for the money expended. A step to meet this demand has recently been made in the design of electric motors, by the adoption of self-aligning ball bearings as a standard of construction by Fairbanks, Morse & Co.

The maintenance expense of these ball bearing motors approaches the zero point, as in most cases the only attention required on their installation is an annual or semi-annual inspection and renewal of the grease which is used for lubrication.



Sectional View of Ball Bearing Motor.

In an inaccessible location or where oiling and inspection necessitates shutting down of other machinery, the saving claimed for these motors is especially large.

While cleanliness is desirable in all machinery, it is especially so in electrical motors. Cleanliness is easily maintained as a result of the use of heavy lubricant with this type of bearing. As a result, this design of ball bearing motor is especially adapted for use in bakeries, clothing factories, confectioneries, and other places where cleanliness is most essential. Only through the grossest of carelessness would it be possible for any lubricant to get on other parts of the machine than the surfaces lubricated.

These ball bearing motors are made in both vertical and horizontal shaft types. The satisfaction derived from their use over long periods of the heaviest service assures their success.

NEWS NOTES

FINANCIAL.

TACOMA, WASH.—Sale at public auction of the property of the Washington-Oregon Corporation, including power projects, street railways and water plants in southwest Washington and Oregon, has been agreed on in Federal Judge Cushman's court. Attorneys reported that opposition had been removed and a decree was presented for foreclosure of a $1,569,000 mortgage against the corporation held by the Fidelity Trust Company of Philadelphia. Properties to be sold include a power and water plant in Hillsboro, Ore., a street railway system between Centralia and Chehalis; a power plant in Southern Washington, serving large areas in that district, and a street railway in Clarke County.

ILLUMINATION.

WILLIAMS, CAL.—The people of this town at a recent election voted for a public lighting system.

ANACONDA, MONT.—The council has adopted a resolu- Collective Gas Exhibit.

BOISE, IDAHO.—The Boise Municipal League is fathering a move to have the city construct a municipal lighting plant.

EPHRATA, Wash—C. J. Weller is planning to move his gasoline plant from Wilson creek to furnish lights for the city.

MILWAUKIE, ORE.—The Portland Gas & Coke Company is to receive a 25 year franchise at the hands of the council.

LOS ANGELES, CAL.—As necessity arises in the recent annexation of the San Fernando Valley and Palms district, the city will extend the lighting system to that territory.

SAN JOSE, CAL.—The city attorney has been instructed to prepare the necessary papers in preparation for the installation of electroliers on West Santa Clara street.

SPOKANE, WASH.—City Engineer Morton McCartney has prepared final report of engineering tests on two prospective power sites for municipal lighting plant.

MODESTO, CAL.—Sealed bids will be received by the county board of supervisors up to June 15th for the installation of a street lighting system in the town of Riverbank.

LOS ANGELES, CAL.—The board of supervisors will receive up to June 14th sealed bids for installing and maintaining a system of street lighting in the Homeward Avenue Lighting District.

ENUMCLAW, WASH.—The transfer of the Enumclaw Light Company's plant to the Puget Sound Light, Power & Traction Company has been made. Representatives of the new company are here making necessary changes.

LOS ANGELES, CAL.—The board of supervisors has referred bids for installing and maintaining a lighting system in the Belevdere Lighting District to the lighting commttee of the district.

RIVERSIDE, CAL.—The board of public utilities has authorized the electric light department to extend the single ornamental lighting system on Lemon street in conformity with the recommendations of the council.

OCEAN PARK, CAL.—The contract for the Culver lighting district has been awarded to the F. E. Newberry Electric Company. The contract for furnishing current for the state lighting system in the same district went to the Southern California Edison Company.

GOLD HILL, ORE.—At a referendum election the question of the installation of a street lighting system and for the installation of an electric pumping system and supplying electric current for the operation of a system by the California-Oregon Power Company was defeated.

TACOMA, WASH.—Petitions are in circulation for the establishment of new lights along South East street from South Fourth to South Twenty-seventh. The Elks lodge and the Union Club have petitioned the light department to install new lights on the block on Broadway between Sixth avenue and South Seventh street and on South Seventh street between Broadway and St. Helens avenue.

LOS ANGELES, CAL.—The J. W. Robinson Company has awarded contracts amounting to $10,000 for the installation of lighting apparatus in its new store on Seventh street. The contracts went to the Johns-Manville Company for window lighting system and lights for all elevators at $8000; the Wagner-Woodruff Company, fixtures at $1500; and the Foulkes Company, cord and socket installations at $500.

SAN FRANCISCO, CAL.—Among the improvements authorized by the Pacific Gas & Electric Company are the following in this district: $50,504, installation of high pressure gas main for peninsula, from Potrero to county line, distance 31,500 ft., of 8 inch welded steel pipe; $41,400, installation of two 822 h.p. boilers, and superheaters at Station A, to enable plant to carry load, equal to installed capacity of turbines; $4078, installation of 93 gas lamp posts, Broadway and Webster, Pacific, between Locust and Laurel.

PORTLAND ORE.—The Rose Festival Association of Portland, Oregon, is installing street decorations for the Festical which is to be held June 9, 10 and 11. The electrical decorations will consist of streamers along the streets, lamp posts equipped with about 5 different colored lights in the top globe, controlled and operated by "skedoodle" sockets. At two street intersections there will be erected two large electrical canopies and at another location an electrical curtain. At the Festival center on five of the Park blocks there has been arranged for thorough illumination. All of the work is being done by day labor and is under the direct supervision of Harold L. Wald, landscape designer. A committee composed of Messrs. F. H. Murphy, F. T. Weber, G. N. Barker, R. F. Monges and R. S. Carroll acted as an advisory board to the Rose Festival Association. There was very little money available this year and every means possible was employed to get as much decoration as possible for the funds available.

TELEPHONE AND TELEGRAPH.

CHOTEAU, MONT.—It is expected that the forest service will build an entirely new telephone line from this place to a point near Strabane.

VALDEZ, ALASKA—The Juneau-Douglas telephone system will be greatly improved, according to the announcement of Edward Webster. The line crossing Gastineau channel, now consisting of two wires, will be increased to four.

TRANSMISSION.

PRAIRIE CITY, ORE.—The entire power plant will be moved inside the city limits.

MORTON, WASH.—C. O. Smith of Pe Ell has purchased the Morton Electric Company and it is understood that considerable improvements will be made.

COLVILLE, WASH.—The Stevens County Power & Light Company has filed application for a franchise to erect a pole line on the Colville-Meyers road. Hearing will be held June 15th.

KELOWNA, B. C.—The council is taking up the matter of a hydroelectric development with the engineering firm of DuCame, Dutcher & Company, Vancouver. The estimated cost is $120,000.

OLYMPIA, WASH.—Bids will be received by the City Clerk until July 7th for furnishing electrical power to this city, according to plans and specifications on file in the office of the city engineer.

SPOKANE, WASH.—The franchise for a power line from Deer Park to the property of the Arcadia Orchards Company has been granted to the Little Spokane Light & Power Company, Deer Park, by the board of county commissioners.

LEWISTON, IDAHO.—The Lewiston-Clarkston Improvement Company may extend its line through the Lewiston orchard tracts south of the city, a distance of seven miles, which means electric light for many of the homes in the tract.

SEATTLE, WASH.—City Engineer A H Dimmick has recommended that immediate steps be taken for the construction of an additional unit to the Lake Union steam power plant at a cost of $350,000 and has asked for $25,000 to continue investigations at Cedar River.

NAMPA, IDAHO.—Stephen Orchard Company has arranged with Mr. O. G. F. Markhus, receiver of the Idaho Railway, Light & Power Company to extend the electric line to their orchards and install sufficient power for pumping 7000 gallons of water daily.

LOS ANGELES, CAL.—Bids will be received by Captain E. L. Walton, constructing quaratermaster, up to June 9th, for the construction of a concrete power plant, light plant and refrigerating plant and machinery at Fort Huachuca, Arizona, in accordance with plans and specifications obtained from constructing quartermaster at Fort Huachuca.

TRANSPORTATION.

TACOMA, WASH.—The Tacoma Railway & Power Company will commence at once to tear up and lay new tracks and foundations on Pacific avenue between S 13th and 7th streets.

SACRAMENTO, CAL.—The Pacific Gas & Electric Company has authorized the following improvements to the local railway: $12,805, reconstructing P street from Third to Tenth, distance 2486 ft., with single track, replacing 40 lb. T rail; $40,926, reconstructing J street from Second to Twelfth, distance 3920 ft., with 87 lb. groove rail to replace 51 lb. rail; $18,406, reconstructing 60 lb. T rail with 87 lb. groove rail and building, a new track running parallel from Stockton avenue on Second avenue to East avenue, thence on Park avenue to Thirty-fifth street, distance 1721 ft.

SAN FRANCISCO, CAL.—Suit has been instituted by the United Railroads to enjoin the city from running "D" and "C" cars upon Market street and from using the loop at the eastern terminus. In the complaints the company sets forth that the increase of municipal cars has caused a big difference in the headway of the private line's cars. The allegation is also made that the United Railroads is losing money on the power sold to the city on account of the greatly increased use. The complaint covers the use of the tracks from Geary to the Embarcadero, the use of electric power on this stretch, the issuance or acceptance of transfers for the designated lines and the carrying of passengers to and from the Exposition on these lines.

WATERWORKS.

PRESCOTT, WASH.—An ordinance has been passed providing for the issuance of bonds in the amount of $15,000 for additions and improvements to the water system.

OLYMPIA, WASH.—An ordinance has been passed by the city council providing for a bond issue of $90,000 for the purchase of the Olympia Water Works, owned by John E. Price.

SAN DIEGO, CAL.—Plans are being prepared for piping spring water in the residence section of La Mesa, establishment of sanitary fountains, and installation of spring water in school buildings.

PHOENIX, ARIX.—The lowest bid received by the city commission for iron pipe and fittings was from the United States Cast Iron Pipe Company and the contract was ordered closed with that company.

VICTORVILLE, CAL.—The board of supervisors has adopted an ordinance granting a franchise to the Appleton Land, Water & Power Company to maintain a system of water pipe lines and mains in this city.

OWENSMOUTH, CAL.—The Owensmouth water plant which supplies this city burned down at an estimated loss of $15,000. The engine house, water tank and tank of oil were destroyed. The pumping engine may be salvaged.

TACOMA, WASH.—The city council has decided to serve the Metropolitan park board with water service if the park authorities will lay a connecting main. The cost of making connections will be about $5000 for cast iron mains.

KELLOGG, IDAHO.—Davis Keese of Pittsburg, one of the owners of the Kellogg Power & Water Company is superintending surveys for a water grade from Big Creek, whence it is proposed to bring a water supply for Kellogg.

EUREKA, CAL.—New shops for the maintenance department of the Eureka water system are to be built at the corner of Sixth and C streets, the water commission having approved the plans. Work will begin in the near future.

PASADENA, CAL.—At a recent meeting of the council the United States Cast Iron Pipe & Foundry Company was awarded the contract for 5800 ft. of four, eight and fourteen inch pipe fittings, weighing 123 tons, for $3896.34, for North Pasadena avenue and West Walnut street.

ST. MARIES, IDAHO—The mayor and city clerk have been authorized to enter into an agreement with the Gerhars-Jaqueth Engineering Company of Great Falls, Mont., to prepare plans for the improvement of District No. 1, which covers plans for water distribution in the city.

OCEANSIDE, CAL.—In a "straw vote" on four items of proposed bond election for municipal improvements, $10,000 for water system improvement, $4000 for wharf, $8500 for city hall, $7500 for pavilion—the vote showed preference for the municipal water and pier improvements.

NORTH YAKIMA, WASH.—As a result of a recent conference between city officials and the members of the state public service commission it is understood that the commission has decided to send its engineers here this summer to make a complete survey of the situation with reference to North Yakima's water supply.

TWIN FALLS, IDAHO.—According to Henry Smith, general manager of the Nevada Copper Mining, Milling & Power Company, work on the water system for the Contact City townsite will begin shortly. A reservoir will be built at the foothills of L. and D. Mountains, and the water supply will be secured from springs and wells.

ABERDEEN, WASH.—A plan to bond this city for $100,000 for the purpose of securing money to build the Wynooche water system was advocated by Mayor J. M. Philips. He stated that a committee of citizens should be appointed to secure the water and power rights of the Wynooche, and to get a right of way for the pipe line.

SAN DIEGO, CAL.—Official report on the Vulcan water system has been submitted by M. M. O'Shaughnessy and J. B. Lippincott, employed by the city to make such a report. It recommends that the Warner dam be developed for hydroelectric power, construction of flume from Warner's to Pamo, conduit from Pamo to San Clemente, and pipe line from San Clemente to University Heights reservoir would cost additional $125,000. The water right is computed at $1,647,000.